THE CORNELL ENGINEER

MARCH 1950
Vol. 15, No. 6

25 Cents
Per Copy

COLLEGE OF ENGINEERING · CORNELL UNIVERSITY

How to make 31,000 people happy

ONE of the biggest single housing developments ever undertaken has taken its place in the panorama of New York City's lower East Side. It is the result of cooperation between private enterprise, the State, and the City.

The rise of Peter Cooper Village and adjacent Stuyvesant Town has changed the face of this 80-acre section of Manhattan . . . has transformed a slum area of tenements and factories into modern, roomy living quarters for 31,000 people.

Many similar projects . . . some perhaps not so large, some even larger . . . must take form before America licks its housing problem. And they'll all require vast quantities of steel, for steel is the backbone of modern construction.

Today the steel industry is looking ahead toward tomorrow's big projects. At United States Steel, a vast training program is going forward continually, preparing men to handle the many highly-technical jobs that modern steelmaking involves. Many of these jobs are far removed physically from the roaring blast furnaces and glowing open hearths —at the same time, they are absolutely essential to today's precision steelmaking.

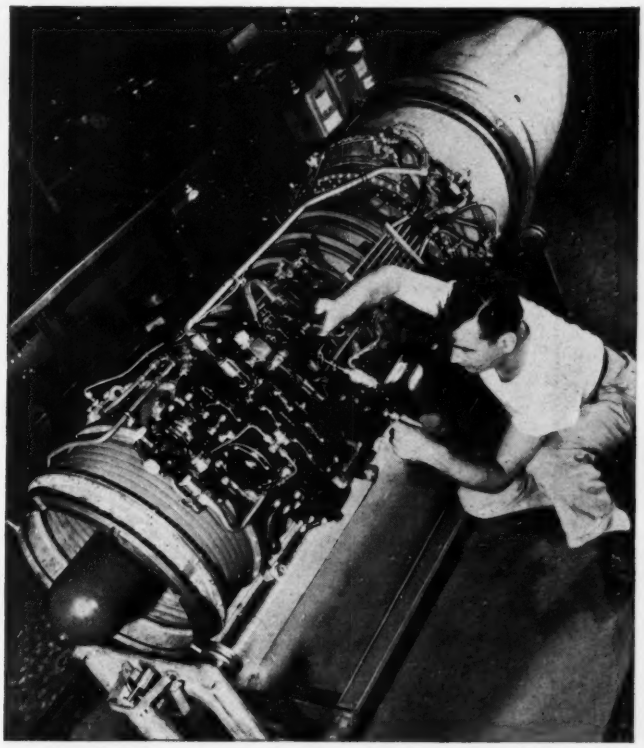
Through its training program, United States Steel is laying the foundations for promising futures for young men who meet its qualifications.

AMERICAN BRIDGE COMPANY · AMERICAN STEEL & WIRE COMPANY · CARNEGIE-ILLINOIS STEEL CORPORATION · COLUMBIA STEEL COMPANY
H. C. FRICK COKE AND ASSOCIATED COMPANIES · GENEVA STEEL COMPANY · GERRARD STEEL STRAPPING COMPANY
MICHIGAN LIMESTONE & CHEMICAL COMPANY · NATIONAL TUBE COMPANY · OIL WELL SUPPLY COMPANY · OLIVER IRON MINING COMPANY
PITTSBURGH LIMESTONE CORPORATION · PITTSBURGH STEAMSHIP COMPANY · TENNESSEE COAL, IRON & RAILROAD COMPANY
UNITED STATES STEEL EXPORT COMPANY · UNITED STATES STEEL PRODUCTS COMPANY · UNITED STATES STEEL SUPPLY COMPANY
UNIVERSAL ATLAS CEMENT COMPANY · VIRGINIA BRIDGE COMPANY

USS

UNITED STATES STEEL

How many Dimensions has a Name?



When you measure a name, there are many "dimensions" to consider, such as: integrity, capacity, vision, strength and skill. These qualities constitute a yardstick for professional and public recognition.

There will be many times in your career when you can increase the "dimensions" of your name by the development of a product, a method or through a decision you make.

Some idea of the dimensions of the name Westinghouse, for example, may be gained by a few facts about one of its many activities . . . building turbines.

In this field is the Westinghouse J-34 jet engine which is setting a new pace in aircraft propulsion in the much-discussed Navy "Banshee" and the Army Lockheed F-90, as well as in many other airplanes of both services—as yet unannounced.

Such developments require a rich background of experience, technical knowledge and creative skill gained through constant search for more efficient, economical sources for power . . . qualifications needed to attain the eminent position the name Westinghouse holds as a leading producer of power equipment for land, sea and air.

This is but one of many fields in which the name Westinghouse has been indelibly written over the years.

In your career you will measure many names and products in industry. As you do, you will find the name Westinghouse prominently identified with practically every one.

Whether those products are turbines or toasters, locomotives or lamps, electric stairways or x-ray machines, we will welcome the opportunity to share our experience . . . our sureness in designing and manufacturing that adds a new dimension to a name . . .

G-10069

YOU CAN BE SURE . . IF IT'S Westinghouse

THERE WOULD BE *Man-made Floods* IN EVERY CITY...

if waste and rain water ran uncontrolled

Uncontrolled . . . water causes untold destruction. Uncontrolled . . . the waters that flow into and out of the buildings you live in, work in and play in would make these buildings uninhabitable. Drains control and regulate the volume and flow of water into pipes and sewers. To design a drain and a drainage system requires engineering skill seasoned by years of experience.

Zurn Engineering, professionally trained and enlightened by the experience of over 40 years, knows service conditions for every type of building and what is required to meet them. First comes the study and analysis of the volume of water to be handled; the time factor—in seconds or minutes; the rate of flow and its force; air pressures; open area ratio; hydraulic head; resistances to flow; temperatures; building design and construction detail and numerous others. Only then does the design or recommendation of a drain begin.

The product of Zurn Engineering is inevitably a drain that performs fully every function, with a wide safety factor, even under unpredictable conditions.

A Zurn Field Engineer represents a vast pool of engineering, production and installation experience that you can utilize in countless ways.

J. A. ZURN MFG. CO.

And Its Affiliate

AMERICAN FLEXIBLE COUPLING COMPANY

Pittsburgh Avenue, Erie, Pa., U. S. A.

ZURN PROVIDES BETTER WAYS TO*...

ZURN

* ...Drain Waste And Rain Water, *FLOOR DRAIN* ➤

...Control Fluids On Ships, *SCUPPER VALVE* ➤

...Control Fluids for Industry, *DUPLEX STRAINER* ➤

...Efficiently Transmit Power, *FLEXIBLE COUPLING* ➤

THROUGH RESEARCH AND ENGINEERING

David G. White, ChemE, '50
Editor-in-Chief

Donald E. Read, ME, '50
Managing Editor

Leo A. Sears, ChemE, '50
Business Manager

◇

Publication Board

Howard P. Kallen, ME, '50
Assistant Editor

John H. Gay, EP, '51
Associate Editor

Robert J. Burns, EE, '50
Illustrations Editor

Howard S. Krasnow, ME, '51
Treasurer

William D. Roberson, ChemE, '51
Advertising Manager

James G. McMillan, Jr., ChemE, '50
Circulation Manager

Thomas J. Kelly, ME, '51
Publicity Manager

William D. Clark, ChemE, '50
Office Manager

◇

Editorial Board

L. Altman, EP, '51
R. Baumgarten, CE, '52
A. Blumstein, EP, '51
R. H. Caplan, ChemE, '51
R. Chittenden, CE, '52
R. S. Critchfield, ME, '53
W. H. Ferguson, ME, '52
N. Kondo, ME, '51
R. L. LaBelle, Chem E, '50
I. Margiloff, Chem E, '53
V. K. Pare, EP, '51
H. E. Petschek, EP, '52
R. L. Rosenthal, ME, '53
B. N. Roth, ME, '51
B. Sachs, EE, '53
G. W. Sutton, ME, '52

◇

Business Board

T. B. Blake, ME, '52
T. S. Foulkes, ME, '53
L. R. Gons, CE, 53
J. F. Lehrer, EE, '53
C. G. Markel, EE, '52
D. C. Matson, ME, '53
D. Plumer, EE, '51
D. P. Victorin, ChemE, '51
M. Zevin, MetE, '53

◇

Advisory Board

Dean S. C. Hollister

Technical Advisers

Prof. R. Y. Thatcher
Prof. M. W. Sampson

School Directors

Prof. C. R. Burrows, EE
Prof. N. A. Christensen, CE
Prof. F. H. Rhodes, ChemE
Prof. L. P. Smith, EP

Alumni

H. H. Williams, Jr., C.E. '26
F. C. Wood, C.E. '24

Founded 1885

The CORNELL ENGINEER

Volume 15 March, 1950 Number 6

CONTENTS

Weldability—Challenge to Research 5
By Howard P. Kallen, ME '50

Opportunities in Research 8
By Dr. Dwight F. Gunder

The Flashbulb, Its Development and Construction 10
By Howard M. Bellis, ChemE '54

Editor's Column 12

College News and Views 13

Engineering College Council 15

President's Message 16

Alumni News 17

Techni-Briefs 18

Engineering Book Reviews 22

Cornell Amateur Radio Club 24

Stress and Strain 40

COVER: View of the War Memorial Arch which constitutes part of men's dormitory group at Cornell University.

Member of The Engineering College Magazines Associated
Chairman, Prof. F. J. Cheek, Jr., Univ. of Kentucky, Lexington, Ky.
Publishers' Representative, Littell-Murray-Barnhill, Inc.
101 Park Ave., New York and 605 N. Michigan Ave., Chicago

Arkansas Engineer
Cincinnati Cooperative Engineer
Colorado Engineer
Cornell Engineer
Drexel Technical Journal
Illinois Technograph
Iowa Engineer
Iowa Transit
Kansas Engineer
Kansas State Engineer
Kentucky Engineer
L.S.U. Engineer
Marquette Engineer
Michigan Technic
Minnesota Techno-Log
Missouri Shamrock
Nebraska Blue Print
New York Univ. Quadrangle
North Dakota Engineer
North Dakota State Engineer
Oregon State Technical Record
Oklahoma State Engineer
Ohio State Engineer
Penn State Engineer
Pennsylvania Triangle
Purdue Engineer
Rochester Indicator
Rose Technic
Wayne Engineer
Wisconsin Engineer

Published monthly—October to May—by the Cornell Engineer, Inc., Lincoln Hall, Ithaca, N. Y. Edited by the undergraduates of the College of Engineering, Cornell University. Entered as second class matter at the Post Office at Ithaca, N. Y., under Section 103, Act of October 3, 1917.

Subscription per year: regular $2.00; with membership in the Cornell Society of Engineers $3.00 (See President's page); student $1.50; single copy $.25.

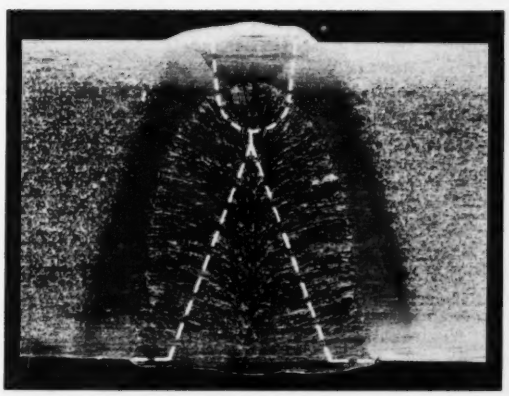
Weldability--

Challenge to Research

Applied Science discovers new facts

By HOWARD P. KALLEN, ME '50

IN recent years a quantitative solution of the problem of weldability has been the target of research groups in many diverse fields. Significant data have been compiled by scientists and engineers with the mutual desire to lay bare the fundamental nature of the problem. The author is presently engaged in an experimental study at Cornell University, the purpose of which is to correlate some of this data.



This section clearly shows the extent of the heat-affected zone. Notice the dendritic structure caused by the variable cooling rate. This is a double-vee butt joint.
—*Courtesy Linde Air Products*

Scope of the Field

The magniture of the work already cannot be fully appreciated without a critical review of the relatively meager information available on this subject just two short decades ago. Turning to the present, we find practical criteria for evaluating weldability in specific applications. These criteria are undergoing evolutionary changes as new information is processed and interpreted. The enormous amount of fascinating work still to be done captures the imagination of the young research engineer looking for fertile fields of study. An examination of available information gives one the feeling that we are on the threshold of vitally important discoveries. One might almost compare it with the state of theoretical mechanics immediately prior to the formulation of Newton's Laws of Motion. Out of the many exhaustive studies will almost certainly emerge the physical laws governing the action of such phenomena as the temperature of transition of a metal from ductile to brittle behavior, cold cracking tendencies, and optimum cooling rates.[1]

Welding plays its part in foundation construction. Here a welder attaches driving tips onto the ten-inch steel pipes that were used for piles to help support the 705,800 pound weight of the boring mill, plus the estimated 576,000 pound weight of its expected heaviest load. In this operation d-c arc welding was used.
—*Courtesy Westinghouse*

If one ventures to arrive at anything but a qualitative measure of weldability, he finds that disagreement exists. It is not that quantitative measures have not been proposed, but that there has been a failure to get the same index of weldability when subjecting the metal in question to the more than one of these tests.[2]

The Definitions Committee of the American Welding Society has defined weldability as: "The capacity of a metal to be welded, under the fabrication conditions imposed, into a specific, suitably designed structure, and to perform satisfactorily in the intended service." It would seem, then, that any numerical index of the property should account for the service use to which the weld will be subjected.

Practical Value of Investigations

After surveying the maze of data, it is rather difficult to determine the direction in which the investigations are moving. A consideration of the question, "Why study weldability?" clarifies this point. From a practical point of view, it can easily be appreciated that the advantages gained by welding in preference to other methods of fabrication, would be lost if it were necessary to build a finished structure for test purposes. Under such conditions we would necessarily have to test the structure for its dynamic (energy absorbing) properties under field conditions. It therefore becomes highly desirable to correlate laboratory performance with field service.

The Lehigh Studies

How far have we advanced in this direction? Two serious attempts have been made to standardize the procedure for evaluating the weldability of a steel, neither being completely satisfactory, but both indicating that a solution is in the offing. The first of these methods was developed at Lehigh University and suggested by Dr. A. B. Kinzel.[3] This method is based on the control of the cooling rate after welding as the fundamental variable. The loss of ductility is presumed to be the result of cooling rates that are rapid enough to cause the formation of the brittle structure Martensite, in the heat affected zone of the weld. In determining the optimum cooling rate for any given metal by the Lehigh method, the direct bead weld test (See fig. 2) for hardenability is first performed. This consists of measuring the maximum hardness in the heat-affected zone of welds deposited at various heat input rates, with measured cooling rates. We then record the bend angle (see Fig. 1) for different hardnesses of slow notch bend specimens made up at different quenching rates. The cooling rate and angle of bend have now both been related to hardness, thus giving us a relationship between cooling rate and bend angle. From the cooling rate necessary to achieve the specified bend angle, we can determine the power input and electrode travel for the welding conditions imposed.

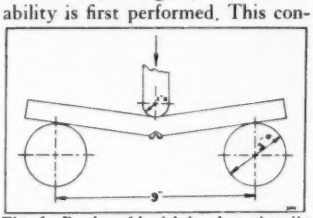


Fig. 1. Bead weld nick-bend testing jig used to determine the weldability of steels by measuring the angle of bend at maximum load.
—Courtesy Welding Research Council

Experimental determinations of factors to account for the geometry of the various types of welds were made. These geometry factors are used to modify the results obtained in the bead weld test, so that the data may, for example, be applied to a fillet weld.

The rate of cooling is a function of the rate at which heat is supplied to the weld and extracted from it, (the latter being proportional to the mass distribution and temperature of the parent metal). It can be seen therefore that we obtain the required cooling rate by using the correct power input, electrode travel, and proper post heating, if any; the mass of the parent metal being fixed by service requirements. Such specific information is foun din tables which are the result of the Lehigh experiments.[2]

The Battelle Investigation

The method devised at the Battelle Memorial Institute is a modification of the Lehigh system, known as the Notched Bead Slow Bend Test.[4] (see Fig. 1). In the process of evaluating the validity of this test, it was found that test specimens of the same material of different thicknesses, resulted in different indices of weldability. That is, thicker specimens showed smaller angles of bend at maximum load in spite of the fact that the power input was increased in proportion to the increase in the thickness of the test specimen. It is readily admitted that a likely flaw in this approach to the problem is the keeping of the depth of the notch in the bead weld constant for all the tests. (see Fig. 2). The possibility of making the notch depth and cooling rate proportional to the thickness suggests itself as a possible new line of attack in order to establish the proportionality principle between thick and thin sections.

At the present time intensive study is being concentrated on the phenomena of transition temperatures. (see Fig. 3). The determination of these temperatures is believed, by some of our leading investigators, to be the key to the solution of the problem. Consistent values of transition temperatures for the different metals would result in these temperatures becoming accurate and reliable criteria which could be used as indices of weldability. It would also be necessary to determine the increase in the transition temperature caused by welding in order to have a quantitative measure of weldability. A number of formidable difficulties have presented themselves in this phase of the investigations. Primarily, it has not been possible to get the same transition temperature for a given material when subjecting it to different types of impact tests over a series of test temperatures. Even with a single test the amount of scatter of the data when plotting energy absorbed versus temperature, has been so great, that it became necessary to set an arbitrary standard deviation for the purpose of fairing in the curves. (See Fig. 3).

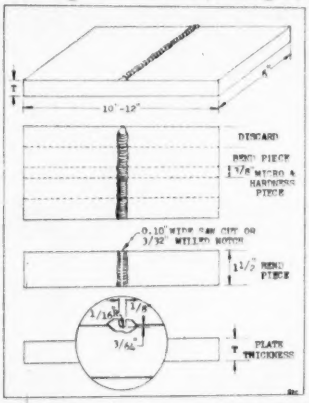


Fig. 2. This sketch shows the standard test specimen for use with the bead weld nick-bend test for weldability as a function of bend angle.
—Courtesy Welding Research Council

The M.I.T. Investigation

Another prominent factor affecting the transition temperature in service was found to be the type of loading. Investigations at M.I.T. have shown that the transition temperature increases as much as 100°F in some cases when changing from a uniaxial to a biaxial state of stress at any given strain rate.[5]

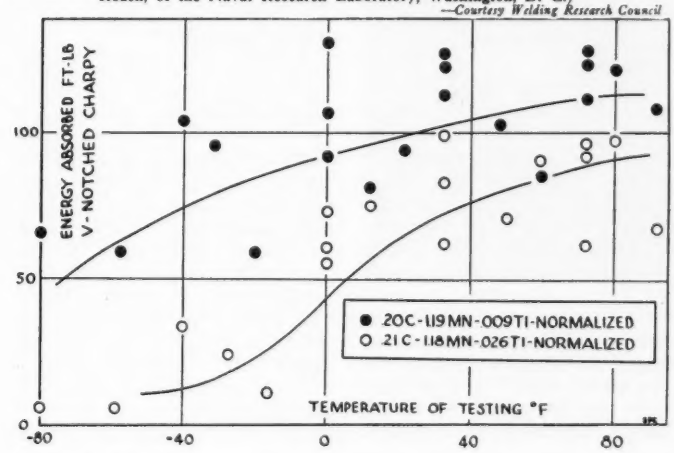
This study consists of isolating each of the variables concerned with the transition temperature, in order to determine their individual effects. The full scope of such an approach can only be realized if one is acquainted with the difficulty of holding an effect constant or even making it proportional to a change in the variable under consideration. Perhaps it may be possible to group the variables which are closely related into dimensionless quantities as was done in heat transfer studies, thus cutting down the number of variables considerably. The goal of such a method would be the development of empirical equations which when applied, would yield a close approximation of optimum welding conditions. (see Fig. 4). The

author plans to embody such a procedure in his present study of the problem here at Cornell.

A rather unusual technique developed at Rensselaer Polytechnic Institute, has been the attempt to produce a homogeneous and continuous structure across the entire crossection of the heat-affected zone. This method consists of controlling the thermal cycle necessary to produce the required structure at each point in the weld. The thermal cycle is controlled by means of resistance heating. This procedure was the outgrowth of a careful study of cooling rates in the heat-affected zone. The practicality of such a method under field conditions is mitigated by the time and equipment involved. For such applications as the welding of tool and die steels, however, the principle is extremely valuable. Considering the fact that tool steels, both water and air hardening, are not readily weldable, it becomes worthwhile to attempt more difficult measures. From a long range cost point of view, thousands of dollars on tools and dies may be saved if worn or "washed-out" sections can be replaced by building them up with steel of the same or superior analysis to that of the original die. It is expected that further research will be undertaken to analyze the phenomena governing the action of high carbon and alloy tool steels, their transition temperatures and optimum cooling rates.

Fig. 3. This graph shows the notched properties of two normalized steels as a function of testing temperature. The large amount of scatter of the data has made it necessary to employ statistical methods to fair in the curves. Notice the adverse effect of an increase in the Titanium content of the steel. (From data by Luther, Hartbower, and Roach, of the Naval Research Laboratory, Washington, D. C.)

—Courtesy Welding Research Council



Possibility of a Theoretical Solution

Some investigators advocate the possibility of a more theoretical solution of the problem. Perhaps the answer to the question, "Why does the transition temperature exist?" could be the clue which might not only result in a method of accurate determination of transition temperatures, but in the control of them as well. Such is the magnitude of the work which challenges the ingenuity of research engineers today.

In this interim period agreement has been reached on a number of important questions, the study of which will serve as a working basis for future experimentation. As a result of the studies on carbon-manganese steels,[6] it has been concluded that carbon is the critical element involved in weldability, and that for a given tensile strength, most other elements are less harmful than carbon.

Previous deformation has been shown to raise the transition temperature. There has, however, been difficulty in separating this variable from the tendency for a brittle fracture to occur due to the structure of the material.

Future Trends

Much work remains to be done, both experimental and analytical, before a satisfactory explanation of a quantitative nature is achieved. Tests must be correlated with field service. This may depend on the availability of failed structures. Correlation of the work of the various investigators would be, in itself, a valuable contribution since it could possibly clarify some of the results, which in some cases are contradictory.

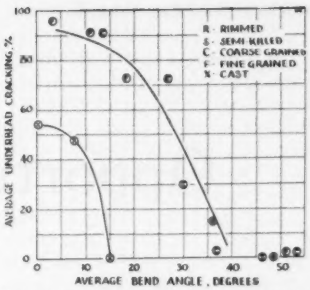


Fig. 4. Relation between bend angle as an index of weldability, and percent cracking. This graph has been somewhat simplified, however the most significant item from the chemical analysis viewpoint, is that the lower percentages of Manganese yielded higher indices of weldability. (From data by Williams, Roach, Martin, and Voldrich, of the Battelle Memorial Institute, Columbus, Ohio).

The successful combination of such variables as loading rate, grain size, forming process (cast or wrought), and aging, would be a big step forward since it would then become possible to attribute the phenomena to specific causes, and further, it might yield a quantitative measure of their effects.

It has been the purpose of this paper to present a picture of the state of flux in which the subject finds itself. It is also intended to bring to the attention of young engineers a field which offers a challenge to the scientific mind, and holds the reward that comes with the satisfaction of adding new knowledge to a subject which is actually in its embryonic stages.

1. Hess, W. F., Merrill, L. L., Nippes, Jr., E. F., and Bunk, A. P. "The Measurement of Cooling Rates Associated with Arc Welding, and Their Application to the Selection of Optimum Welding Conditions," Welding Research Supplement, 377-s to 422-s (1943).
2. Guide to Weldability of Steels, American Welding Society. See also, Stout, R. D., Tor, S. S., and Doan, G. E., "The Direct Weld-Bead Test for Hardenability", The Welding Journal (Dec. 1945).
3. Dr. A. B. Kinzel, President of Union Carbide and Carbon Research Labs. Inc., Vice-President of Welding Research Council.
4. Voldrich, C. B., Harder, O. E., "Review on the Weldability of Carbon-Manganese Steels," Welding Research Supplement, 326-s to 336-s (July 1949).
5. DeForest Brittle Temperature Project, sponsored by National Defense Research Committee, 1945, at Massachusetts Institute of Technology, Cambridge, Mass.
6. Voldrich, C. B., Williams, R. D., Roach, D. B., and Martin, D. C., "The Weldability of Carbon-Manganese Steels" Welding Research Supplement, 311-s to 325-s (July 1949).

Opportunities in Research

By DR. DWIGHT F. GUNDER

WHEN I was asked to write on the subject of opportunities in engineering research the first thing that came to mind was to prepare a list of some of the opportunities with which I was familiar and to go into some detail as to the exact nature of the work which needed to be done and which was being done in these fields. On second thought it has seemed much more pertinent not to merely list what might be known to me, but rather to discuss ways and means by which an engineer may find out for himself what is being done in engineering research. As a result of these preliminary thoughts, let us discuss together ways of discovering what is being done and, if possible, deciding what is most interesting to us. In the course of this discussion it will be inevitable that we will also consider some specific examples.

As we approach the question of what research is being done in a given field, we immediately think of the following possible sources of information:

Sources of Information

1. Discuss research activities with university staffs and with representatives of research groups.

2. Visit research groups, both industrial and governmental, to obtain first hand information as to their activities.

3. Peruse the current literature in the several journals which publish the majority of the reports of research work.

Any one of the three methods listed is a sensible one to use in approaching the question at hand. There are, however, definite limitations of time and money which are available to each of us for such a study. Consider, for example, the case of the engineering student who plans to graduate at the end of the present academic year and who thinks he might be interested in research work. He can avail himself of method (1) to the extent of local staff plus such representatives of industry as occasionally present lectures on the campus or within reasonable distances thereof. Some use may be made of method (2) in the case of senior trips or of visits to research groups which are accessible. Probably the best approach, however, is method (3). Certainly it has the advantage of being inexpensive. Just how can it be utilized?

Example Cited

To avoid talking too much in generalities, let us now choose a specific field. In order to obtain at least some coverage in all of the engineering fields I shall select applied mechanics. This will be convenient not only because it does have ramifications leading throughout all engineering but also because it is a field somewhat more familiar to me. When I say that applied mechanics reaches into all branches of engineering, I believe I am making no exaggeration. Included within it are such diverse topics as soil mechanics, structures, automatic control mechanisms (both mechanical and electrical as well as hydraulic), the electrical, chemical and mechanical properties of materials, heat transfer, aerodynamics, et cetera. In searching for new developments, no matter what your field of interest, you should always survey the journals in applied mechanics along with your more specialized technical journals. We are thus confronted with a somewhat formidable array of literature since we must remember that not only are there English and American journals but that there are the equally important ones in French, German, Japanese and Italian as well as the new group in Russian and many others. Certainly there is an abundance of material to survey; in fact the problem now becomes one of obtaining any real coverage of all this material without an excessive expenditure of time. Fortunately for all of us there has appeared since the recent war a new journal called the Applied Mechanics Reviews. This journal attempts to abstract the world literature in applied mechanics. It will serve us well in our present purpose.

Use of Periodicals

I am just now looking at the November 1949 issue of the Applied Mechanics Reviews. Here are a few of the general topics covered in this particular issue: Gyroscopics, Governors, Servos, Vibrations, Balancing, Wave Motion, Elasticity, Failure of Materials, Material Test Techniques, Mechanics of Forming and Cutting, Hydraulic Transport, Compressible Flow, Heat Transfer, Soil Mechanics, Lubrication. For no apparent reason the hydraulics heading catches my eye, so I turn to the page reference to find three articles summarized for this particular month. One deals with capil-

lary pressures, their measurement and use for calculation of permeability; one investigates the discharge coefficients of chamfered orifices and nozzles; and the last has to do with the design of a silt-trapping basin at the confluence of the Manchester Canal and the Mersey River in England. The second of these looks the most interesting just now since it reminds me that I listened recently to a discussion of the effect of entrance conditions in an orifice on the discharge coefficient. The parties involved had just discovered an unexpectedly low discharge coefficient in a newly designed orifice and were particularly disturbed because of the corresponding large pressure drop required to maintain a given fuel discharge into a rocket chamber. I must look further into this myself but you are not interested in that phase of our exploration except in one respect. Suppose you are interested in doing some investigation in this field; then you, too, will go to the original article and read it with care, not necessarily to evaluate the results obtained, but to see just what was done, who did it and, more especially, where the work was carried on. If you become interested there will doubtless be a bibliography with the article providing clues to further reading. Finally you will also now want to discuss the topic with someone on the Cornell staff who may be able to give you further information. You may not know whom to approach on this question since probably there are men having experience along these lines in Civil Engineering, Mechanical Engineering, Aeronautical Engineering and Chemical Engineering. Ask the first one who comes to your mind. If he doesn't know, he can probably guide you to someone who does. If your interest continues to develop, you will continue your reading and discussion until you decide to write to one or more of the groups sponsoring the research in which you are interested for further information and perhaps finally to apply for employment.

There is still one possibility which we have not covered. In the Reviews you may not find any topic of particular interest to you. This is quite possible if, for example, you think your interest might lie along the lines of doing research in the field of electrical power transmission. Go then to the technical journals in the field of electrical engineering and proceed in a similar fashion.

Advice To 5-Year Students

Before closing these remarks I should like to point out to those of you who are in Cornell's new five year engineering curriculum that here is the ideal opportunity for you to get a taste of the research problem. In your senior year you are confronted with the question of selecting a project. Several of you have talked to me about this. You are concerned about selecting a topic for your project. You are not sure even of the field in which you would like to work. You may even be reluctant to talk with staff members for fear of committing yourself before you have explored enough possibilities. In the procedure which we have just discussed I believe you will find the ideal Montgomery Ward or Sears, Roebuck catalog in which you can do your shopping. Perhaps you may be able to find just the subject you want this way; more probably you will find several subjects, but with the information you have obtained you will be able to make your final selection with a better knowledge of the state of the market.

Even after selecting a topic for your fifth year project you may be doubtful of your ability to carry it out. This doubt you should dispel at once. The work which is being published is not the output of only a few geniuses in the field. It represents the work of many men of all degrees of capability, some working as individuals but mostly working as members of teams under guidance. With the valuable experience gained from your project you will be able to enter the engineering field not only with training over and above that of the average graduate of a four year curriculum but wtih the added advantage of having worked through a typical engineering research, design or administrative problem.

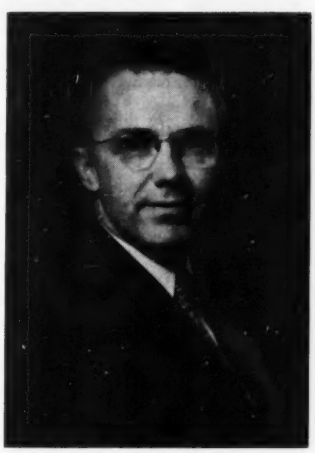
In closing these somewhat rambling remarks let me say only that if you are interested in discovering the opportunities in engineering research, you have the means at hand for discovering them and furthermore, if you happen to be in the five year curriculum, you can even try a project to see whether or not you want to work in this direction.

THE AUTHOR

Dr. Dwight Francis Gunder, head of the Engineering Mechanics Department and Acting Head of Engineering Materials, was born in Ames, Iowa. He received his B.S. and M.S. from Iowa State College, and then went to the University of Wisconsin where he acquired his Ph.D. Dr. Gunder has served on the faculty of Iowa State College and Colorado State College, in addition to his present teaching, research, and administrative duties here at Cornell.

The many contributions which Doctor Gunder has made to the engineering profession, are manifested in his industrial and scientific background. From 1943 to 1945 he was Senior Engineer, Rocket Research Division Army Ordnance; Consultant to M. W. Kellogg Co., Hercules Powder Co., Cornell Aeronautical Laboratory and Brookhaven National Laboratory.

His fraternal and professional affiliations include Phi Kappa Phi, Pi Mu Epsilon, Sigma Xi, Sigma Tau, A.S.M.E., A.S.C.E., S.P.E.E., A.S.M., A.S.T.M., and A.M.A.



Dr. Gunder

The Flashbulb

Its Development and Construction

By HOWARD M. BELLIS, ChemE '54

Photographs Courtesy General Electric

THE development of the photoflash lamp will probably go on record as one of the greatest aids to photography during the first half of the twentieth century. The flashbulb has made it possible for the photographer to carry his light source with him in a compact, efficient form. Unlike the flash powder that was formerly used by a few professional cameramen it can be used safely and easily by anyone who can operate even the most simple camera. The present-day popularity of flash can be well illustrated by the fact that in 1948 over 146,000,000 bulbs were produced.

The use of flash in photography is not limited to the amateur or professional photographer. It is of great aid to scientists, police departments, newspapers, advertisers, and a host of others too numerous to mention. It allows the newspaper man to get photographs that would be otherwise unobtainable. It has been invaluable to law enforcement agencies in the collection and preserving of evidence against criminals. It has made possible the unposed, natural looking photographs that are representative of today's magazine and newspaper advertisements. It could easily be said that the development of the photoflash lamp has, in some way, benefited every person in this country.

Former Methods

Before the introduction of the flashbulb, indoor photography was

Flashbulb synchronized to Speed-Graphic camera makes a portable supply of adequate light relatively simple.

almost completely dependent upon the use of flash powder which had been in use since shortly after the Civil War. This compound, more or less satisfactory as far as light quality was concerned, was disliked because of its cumbersome handling qualities. Although the ignition of the powder produced a brilliant flash, the only satisfactory way to start the reaction was to bury electric wires in it and then send a current through them. Flash powder had problems that make battery failure, the flashbulb user's only worry, look simple. It was necessary to keep the mixture perfectly dry, since any moisture present would have reduced its combustibility. The ignition wiring that was necessary was complex compared with the almost foolproof flashguns that are in use today. Everything considered, the advent of the flashbulb was a welcome relief for the photographer.

Construction and Operation

Essentially, a flashbulb is a sealed container in which finely divided aluminum (or aluminum alloy) is made to react with pure oxygen, producing a brilliant white flash. In order to ignite the aluminum, a current is passed through a tiny tungsten filament in the bulb. This filament is coated with a highly combustible primer compound. When a current is applied to the lamp the tungsten becomes white hot and the primer compound is oxidized. Hundreds of sparks from the burning primer are sent toward the aluminum. Upon contact the oxidation of the aluminum is started. The entire operation, from the application of the current to the end of the flash, takes but a few thousandths of a second.

The manufacture of a flashbulb is far more complex than the average person imagines. Standards must be carefully controlled to insure that each lamp will behave exactly as it is supposed to. Any change in the amount of material in the bulb would alter its firing and light output characteristics siderably. In a photo lamp factory the parts which make up the finished bulb are carefully assembled. As an example let us see how the General Electric number five bulb is made:*

The first step is to cut glass

tubing of .2 cm. outside diameter into lengths of about 8 cm. At the same time a shorter piece of tubing, its diameter about .7 cm., is given a flare. These two pieces are then assembled, under heat, together with two lead-in wires to form a mount for the bulb's filament. In this operation the thin tubing is attached to the flare tube in such a way that its opening is unobstructed. Later, this opening will be used to withdraw the air from the bulb. It is interesting to note that this inner sub-assembly is stamped with a number, which is changed monthly. In this manner any lamps that show peculiarities in operation can easily be isolated from other stock.

The lead-in wires are composed of three individual parts which are welded together. The part that will be outside the glass bulb is made of pure copper. The part that will extend into the inner bulb is made of nickel-plated iron. The section that will pass through the glass is made of a material called dumet. The reason for the nickel plating on the inner wire is to prevent the iron from catching fire when the bulb is ignited. During the last war it had to be dispensed with, and as a result many photographers experienced a red "after glow" that was caused by the burning of the iron wire. A special material is used to conduct the current through the glass because ordinary wire of copper or iron has a coefficient of expansion that is different from that of the glass. Hence unless a special type of wire is used there will not be an air-tight seal where the wire enters the bulb. Dumet consists of a core of nickel-iron alloy in a sheath of copper. It expands and contracts at the same rate that the glass does and therefore does not permit an opening to form when the molten assembly cools.

Once the mount has been assembled, the two lead-in wires are placed at the proper distance from each other and then notched at a point close to their upper ends. Into these notches an extremely fine tungsten filament is placed. This completes the electric circuit within the lamp.

Next, the primer coating, a highly combustible complex chemical, is placed on the ends of the filament. When a current is passed through the bulb, the tungsten will become white hot almost instantly. The heat that is generated at this time is enough to start the oxidation of the primer. This reaction is responsible for the flash-producing ignition of the metal in the lamp.

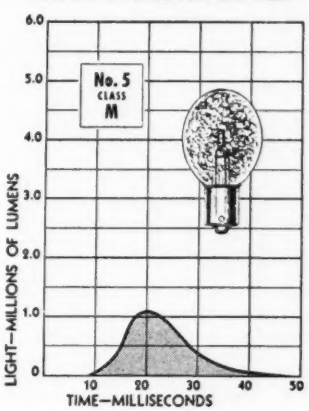
Assembly

The inner assembly is now ready to join the glass bulb assembly which has been constructed in another part of the factory. The glass enclosure is first given an inside coating of clear lacquer to protect it from shattering in case it comes in contact with any hot aluminum during the firing operation. The next step is to give it a load of aluminum. Extremely thin sheets of pure aluminum foil are placed in a machine which shears off uniformly thick shreds in the same manner in which a plane cuts shavings from a piece of wood. When the correct number of these shreds are ready they are loaded into the glass bulb which is now to be attached to the filament assembly.

In this operation the flare of the larger diameter tube in the inner sub-assembly (i.e. — the filament mount) is made to meet the open edge of the glass bulb. The two are then sealed together by heating.

The next step is to replace the air in the lamp with oxygen. To accomplish this, the air is removed through the smaller diameter glass tubing, which now extends from the inside of the bulb, through the filament mount, to the outside of the lamp. The bulb is then flushed out with an inert gas which is withdrawn and replaced with a carefully measured amount of pure, dry oxygen. The photoflash lamp is now complete, since it would be ignited if a current were applied to its outside wires.

Fig. 1. Flash intensity as a function of time for a between-the-lens bulb.



Historical Background

The photoflash lamp was invented in Germany in 1929 by Johannes Osternmeir. It was introduced in the United States by the General

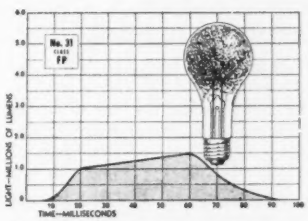


Fig. 2. Flash intensity as a function of time for a focal-plane bulb.

Electric Company in 1930. The original G.E. flashlamp consisted of a glass bulb containing about 0.065 gm. of 0.0004 cm. thick aluminum foil and pure oxygen at a pressure of 170 mm. of mercury. In 1937 the Wabash Photolamp Corporation placed on the market a bulb that contained finely drawn aluminum-magnesium wire rather than aluminum foil. The oxygen pressure in this lamp was about 300. mm., or nearly twice that of the G.E. bulb. The main advantage of wire over foil lies in the fact that foil filled lamps emit a light of very high intensity but have a very short flash duration. This makes synchronization with the camera shutter rather difficult. Wire filled bulbs, on the other hand, have a longer flash duration because more time is required to burn the wire than is necessary to oxidize the relatively thin foil. It was for this reason that General Electric and Westinghouse added wire filled lamps to their lines of flashbulbs shortly after the Wabash bulb was introduced. Further research on the part of G.E. led to the development of the shredded-foil filled lamp. It was discovered that finely shredded aluminum foil, which resembles extremely fine wire in appearance, possessed the advantages of increased light output, su-

perior flash duration, and increased economy in manufacture. At the present time all Wabash (Sylvania) bulbs are wire filled and most lamps made by General Electric and Westinghouse are shredded-foil filled.

Present Models

Most photoflash lamps in use today are designed for use with between-the-lens camera shutters. This type of shutter exposes the entire film area to light at the same time, making it necessary for a flashbulb used with it, to have a comparatively short flash duration.

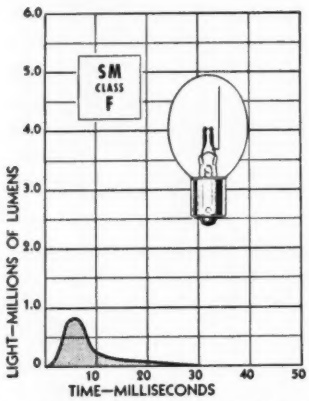


Fig. 3. Flash intensity as a function of time for a speed midget lamp.

In between-the-lens bulbs the aluminum load starts to burn about ten milliseconds (1/100 sec.) after the firing current is applied. (See fig. 1). The light intensity of the flash is not instantaneous, but builds up to a peak and then subsides as the flash ends. It takes about twenty milliseconds for a mechanical flash synchronizer to open a camera shutter. For this reason, most bulbs are designed to reach a peak intensity twenty milliseconds after the firing current is applied. There are some lamps, however, that do not follow this rule.

The focal plane shutter differs from the between-the-lens shutter in that it exposes various parts of the film at different times. (See fig. 1). It may take up to sixty milliseconds to expose the whole film area although the actual exposure for each part of the mulsion may be as short as one millisecond. This means that flashbulbs suitable for use with focal plane shutters must have very long flash durations. In order to do this two carefully selected sizes of wire (or shredded foil) are included in the bulb. When the flash from the wire of smaller diameter has reached its maximum light intensity the flash caused by the oxidation of the larger wire is just about to reach its peak. Hence the time-intensity curves of the two sizes of wire join together to form a curve that has an almost continuous peak that lasts for twenty to forty milliseconds.

For Short Exposures

When short exposures using flash lighting are made with between-the-lens shutters, only a small part of the whole flash output is actually used. A good part of the flash occurs either before or after the shutter is opened and is therefore wasted. In order to do away with this waste of light the General Electric Company developed the Speed Midget lamp. (See fig. 3). This bulb, unlike most others, contains no metal wire or foil. The source of its flash is a highly combustible compound that resembles the primer compound which is used to start the reaction in metal filled bulbs. This substance burns much faster than aluminum, hence its flash duration is considerably shorter. About seventy-five per cent of the light output of a S.M. bulb is emitted within five milliseconds. In order to increase the efficiency of this lamp at high shutter speeds its time lag has been reduced to five milliseconds, the time necessary for a between-the-lens shutter to open completely after it has been tripped. If the firing current is applied just as the shutter is tripped the shutter will be wide open when the flash is at its maximum intensity. Because of its short time lag the Speed Midget lamp cannot be used with most synchronizers designed for use with bulbs of normal time lag.

The color temperature of the light given off by most photoflash lamps is about 3800 degrees Kelvin. Color film is balanced for use with daylight (6500°K) or artificial light (3200°K). Because of this, flash produced light must be corrected to make it suitable for color work. Although this correction can be

(Concluded on page 38)

The Editor's COLUMN

Parting Hopes

On the 29th of next month, it again becomes the duty of the Engineering College to be host during the now-annual Engineers' Day at Cornell. In certain respects, this event has given the opportunity to any students of the College to acquire recognition through the display and demonstration of the prominent field of study in which they are now engaged. However, the possible significance and objectives that Engineers' Day can achieve do not by any means end here.

It is the belief of many of the College's administrators and students that Cornell Engineering is a leader in the field of engineering education in America. The advent of the five-year program here at Cornell was the forerunner of a general trend now developing in the whole field of education.

Nevertheless, education is a business, just like any other undertaking. And public relations is an important part of education, just as it is in any business enterprise. Engineers' Day becomes in this respect a day which certainly should provide added impetus to the growing recognition of the high standards of Cornell Engineering.

At the same time, however, realization of these possibilities requires added regard of both the faculty and the students for the College. One of the best ways in which this objective can be reached is by an attempt, on both the parts of the staff and the students, to better student-faculty relations. Certainly, this would improve student morale in the College, the effect of which is much more widely felt than many suppose.

In conclusion, it is the parting hope of the retiring senior board of this publication that the CORNELL ENGINEER during our tenure has played its part well in giving deserved credit to the ideals of the College of Engineering at Cornell.

D.G.W.

College News and Views

"Engineering at Cornell"

A new edition of "Engineering at Cornell," has supplanted the old, bringing its picture story of the College of Engineering up to date. For eleven years the older edition has served to introduce the College of Engineering to entering students in engineering. Distribution of the attractive brochure is made to college counselors in high schools throughout the country, to Alumni Secondary School Committees, and to entering freshmen.

Radio Telescope

Cornell University's radio telescope received new recognition in the January issue of Pageant magazine. "The Great Discovery of 1949" are listed by William L. Laurence, Pulitzer Prize Science Reporter for the New York Times, who inspected the radio telescope at a symposium on radio astronomy conducted by the College of Engineering in October, 1948. Other scientific achievements of the past year included in this review are the giant cyclotron at Berkeley and the 200-inch telescope at Palomar.

Dr. Albert Walker

On Wednesday evening, February 15 in Olin Hall, Dr. Albert C. Walker of the Bell Telephone Laboratories talked and showed colored films on "Growing Piezoelectric Crystals." The lecture was sponsored by Sigma Xi. During the recent war the Bell Laboratories "grew" crystals of ammonium dihydrogen phosphate for use in underwater sound-detecting equipment. Such a crystal is piezoelectric—meaning that it has the property of developing electric charges on its surfaces when subjected to mechanical pressure, thus converting mechanical energy to electrical energy, or vice versa. Dr. Walker is a graduated of M.I.T. with the Ph.D. from Yale, and has been with Bell Laboratories since 1923.

WITH the advent of a new publication board to formulate and guide the policies of the CORNELL ENGINEER, recognition is certainly due the group of seven men whose places they are taking. The 1950-51 board congratulates them for providing leadership and direction to the magazine and wishes them success in all post-graduation plans.

Obviously, the first man to be considered is DAVE WHITE, who, for the past year, very capably ran the magazine from the editor-in-chief's desk. When Dave came back to the ChemE School after a spell in the Army Signal Corps, he set out again to make his mark on the Hill, both in scholastic and in extra-curricular activities. His success has been well demonstrated by his election to Tau Beta Pi, Pros Ops, and Pi Delta Epsilon honoraries, in addition to his post on the ENGINEER. His musical inclination shows itself in his work for the Big Red Band (Dave's instrument is the bass horn) and his spare-time relaxation at the piano, in whatever spare time he has. Dave has not yet decided definitely what he will do when he gets his B.Chem.E. this June, but he does expect to go to graduate school in chemistry.

The man who, in the last analysis, puts the magazine together into final shape, is the managing editor —a job performed capably and efficiently during this past year by DON READ. Don, a prospective June graduate in mechanical engineering, joined the ENGINEER board in the spring of 1947 and worked from there to his now-completed top level job. Despite the time required by such a position on the magazine, Don has made a fine record in his other campus interests. He is a member of Alpha Delta Phi fraternity (and, incidentally, of the very fine Alpha Delt barber shop quartet), the Men's Glee Club, the Ski Club, Pi Delta Epsilon, and Atmos honoraries. Don's major interest academically lies at this point in the field of agricultural machinery. He is taking courses in the department of Ag Engineering and is assisting in a special problems course given by the department this term. Production or testing of this machinery are his hopes for employment after graduation.

LEO SEARS makes up the third of the top-level triumvirate that directed the activities of the ENGINEER during 1949-50. Leo, who will receive his bachelor's in chemical engineering this spring, held the

Dave Leo Don

post of business manager of the magazine—a job which entails, in essence, keeping the whole undertaking on a sound financial basis. Leo also has made it a point to extend the scope of his activities beyond the magazine. He is a member of Tau Beta Pi, is president of the Cornell chapter of Alpha Chi Sigma, chemical engineering fraternity, and was a charter member of the Engineering Council. Leo intends to enter either the production or the development phase of chemical engineering after graduation.

HOWIE KALLEN, assistant editor of the magazine, has had the responsibility of providing high-caliber technical articles during the past year, and the interest expressed by readers on several occasions has justified his editorial ability in this respect. Howie's other major contribution to the ENGINEER has been his ability to turn out consistently good line drawings, cartoons, etc., as required during the preparation of an issue. In fact, his primary interest outside of engineering lies in fine arts—a field in which he has won several prizes for oil paintings. Howie, scheduled to receive his ME degree this June, has been vice-president of Tau Beta Pi, treasurer and rushing chairman of Tau Epsilon Phi and a member of Pi Tau Sigma. Other accomplishments during his undergraduate years have included winning a McMullen Undergraduate Scholarship and several ASME public speaking awards. Howie hopes to find employment in the field of development engineering after graduation.

The job of ensuring that the ENGINEER has had its full quota of line drawings, cuts, photographs, etc., has been handled during 1949-50 by BOB BURNS, member of the electrical engineering class of 1950. In addition to working with the ENGINEER board, Bob has served as a member of the Engineering Council and Tau Beta Pi, vice-president of Eta Kappa Nu, vice chairman of the student chapter of the AIEE, and secretary of Phi Kappa Tau fraternity. Bob's plans are not definite but he will most likely follow his natural bent and go into some phase (we would guess administrative) of electrical engineering.

BILL CLARK has held the job of office manager of the CORNELL ENGINEER during the past year and has quite capably seen to it that the necessary equipment for producing an issue each month has been available and easily accessible. Bill, the only married member of the publication board, attributes much of the quality of his work to this fact. Bill's campus interest and activity have not been limited as might be expected by his preoccupation with his family since he belongs to both the AIChE and Alpha Chi Sigma, and has served as recorder and vice-president of the latter. The fields of plastics and oil refining are his primary interests for post-graduation employment.

The circulation manager of a magazine has the responsibility of, first, setting up and maintaining a subscription list and then seeing to it that all subscribers receive the magazine promptly. JIM McMILLAN, the fourth member of the publication board who is scheduled to receive his ChemE degree in June, has performed these duties for the ENGINEER during the past year in addition to his not inconsiderable work with other campus organizations. Jim has served as president of Sigma Nu fraternity and as a member of the Interfraternity Council Planning Board and will act as ChemE school chairman for the forthcoming Engineer's Day. Jim's other work with the Engineering Council has been in his capacity of Tau Beta Pi representative to the council. Plans for the future are not settled as yet, two possibilities, however, being considered most strongly—studying at the University of Delaware for a Master's Degree or going to work directly in the industrial field.

Bill **Jim** **Howie** **Bob**

Gas Turbine Book

A new book, "An Introduction to the Gas Turbine" by D. G. Shepherd, Assistant Professor of Mechanical Engineering, has recently been published by D. Van Nostrand, Inc. Not only does it cover in full the calculations and design of gas turbines, but it also includes a comprehensive account of present-day designs and the trend of their development. Drawing on his experience with Power Jets (Research and Development), Ltd., Professor Shepherd discusses in detail the axial-flow and propellor-jet engines used in modern aircraft.

Morse Telegraph

The historic Morse telegraph instrument usually on display in the Engineering library is out on loan. The National Academy of Design is including it in its exhibit of the scientific and artistic work of Thomas Morse in New York City in connection with the Morse Centennial. It is the instrument on which the original telegraph message, "What Hath God wrought?", was received on a line extending between Baltimore and Washington. Hiram Sibley gave the instrument to Cornell.

New Courses Offered

Several new courses are being offered in the College of Engineering this term in keeping with the continued effort to provide the student with a well-rounded, up-to-date engineering education. In the

(Continued on page 26)

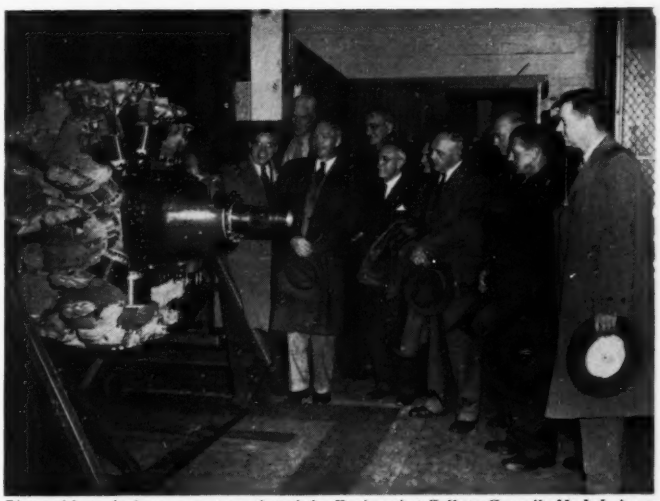
Engineering College Council

Last fall a group of prominent Cornell engineering graduates met with representatives of the College of Engineering to discuss the operations and future development of the College. This group—the Engineering College Council—meets twice a year to review the facilities of the College and to advise the administration and the Board of Trustees with regard to policies and programs designed to increase the efficiency of the established operations.

The members are chosen for their prominence in industry and for the closeness of their contact with industry and the engineering profession. Two men are appointed from each of the fields of Electrical Engineering and Engineering Physics, Chemical and Metallurgical Engineering, Mechanical and Aeronautical Engineering, and Civil Engineering. They serve for a term of two years but they may be reappointed. The President of the University, The Dean of the College of Engineering, and the past president of the Cornell Society of Engineers are members ex-officio.

Chosen from the field of Electrical Engineering and Engineering Physics are Mr. Oliver Ellsworth Buckley, President of Bell Laboratories, and Mr. John Crosier Wilson, Vice-President of The Cutler Hammer Manufacturing Company. Mr. Buckley received his Ph.D. from Cornell in 1914 and then joined the Engineering Department of Western Electric Company. From 1925 until the present he has been with Bell Laboratories. His inventive abilities have earned him membership in Sigma Xi, Phi Beta Kappa and Phi Kappa Phi. Mr. Wilson graduated from Cornell in 1906 with a degree in Mechanical Engineering and became associated with Fore River Shipbuilding Company. Since 1910 he has been with Cutler Hammer Incorporated.

The field of Chemical and Metallurgical Engineering is represented by Mr. Lee H. Clark, Vice-President in Charge of Development for Sharples Chemical Incorporated,



Pictured here during a recent meeting of the Engineering College Council: H. J. Loberg, Acting Director M.E., J. C. Ward, Jr., Dean S. C. Hollister, A. W. Dann, F. W. Scheidenhelm, C. R. Burrows, Director E.E., Creed Fulton, representing the Cornell Society of Engineers, O. E. Buckley, L. H. Clark, and N. A. Christensen, Director C.E.

and Mr. Harold Walter Elley, Chemical Director of DuPont Research Laboratories. After receiving his Bachelor of Chemistry at Cornell in 1919, Mr. Clark joined General Chemicals Company as a chemist, and in 1929 became associated with Sharples Chemicals. He is a member of Tau Beta Pi and Sigma Xi. Mr. Elley completed his undergraduate studies at Nebraska University where he received his B.S. and M.A. degrees. He then taught at Cornell for four years prior to receiving his Ph.D. in 1916. Since then he has been with DuPont.

Mr. James Wentworth Parker, President of the Detroit Edison Company and Mr. John Carlton Ward, President of the Fairchild Engine and Airplane Corporation, were appointed from the field of Mechanical and Aeronautical Engineering. Upon graduation from the Mechanical Engineering School at Cornell in 1914, Mr. Ward became development engineer for International Paper Company and in 1940 he was put in charge of an advisory mission to the French government on airplane engine production. Mr. Ward has been president and director of Fairchild since 1940. Mr. Parker received his M.E. degree from Cornell in 1908 and became plant operating engineer for the DeKalb Power and Lighting Company. Two years later he started his association with the Detroit Edison Company and became president in 1944. He is a member of Tau Beta Pi and Sigma Xi.

The fourth field, that of Civil Engineering, is represented by Colonel Frederick William Scheidenhelm, consulting engineer, and Alexander W. Dann, Executive Vice-President of the Dravo Construction Company. Mr. Dann graduated from the School of Civil Engineering at Cornell with the class of 1907. Colonel Scheidenhelm graduated from Cornell in 1906 with the A.B. and C.E. degrees. Between his graduation and the first World War, he held positions as a construction and hydraulics engineer. He rose to the rank of Colonel during the war and received the Distinguished Service Medal from the president of the United States. In 1917 he received the Fuertes gold medal from Cornell University.

Cornell Society of Engineers

107 EAST 48TH STREET 1949-1950 NEW YORK 17, N. Y.

WILLIAM LITTLEWOOD, *President* .....166 Brompton Road, Garden City, N. Y.

ROBERT M. SMITH, *Executive Vice-President* 210 Orchard St., East Rutherford, N. J.

PAUL O. REYNEAU, *Secretary-Treasurer and Representative, Cornell University Placement Service* 107 East 48th St., New York 17, N. Y.

WALTER M. BACON, *Recording Secretary* .....510 East 84th St., New York 28, N. Y.

WILLIAM F. ZIMMERMAN, *Vice-President* .....103 Archer Road, Syracuse, N. Y.

EUGENE A. LEINROTH, *Vice-President* 17th and Cambria Sts., Philadelphia 32, Pa.

VINCENT D. GERBEREUX, *Vice-President* 82 Inwood Rd., Upper Montclair, N. J.

LINTON HART, *Vice-President* .....418 New Center Bldg., Detroit 2, Mich.

THOMAS S. McEWAN, *Vice-President* .....1046 Dinsmore Road, Winnetka, Ill.

Honorary President: S. C. Hollister, Dean of the College of Engineering

Honorary Vice-Presidents:

C. R. Burrows, Director of the School of Electrical Engineering

N. A. Christensen, Director of the School of Civil Engineering

F. H. Rhodes, Director of the School of Chemical and Metallurgical Engineering

W. R. Sears, Director of the Graduate School of Aeronautical Engineering

L. P. Smith, Director of the Department of Engineering Physics

William Littlewood

"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University its graduates and former students and to establish a closer relationship between the college and the alumni."

President's Message

GRANDMA HAD ONE

Engineers are familiar with gauges, tachometers and Johansson blocks. All are important measuring devices; yet they are no more important to us than the yardstick was to Grandma. With the advent of ready made clothes the yardstick lost its popularity; and, similarly, as students advance along the road of business success they have less need of tangible devices such as gauges and tachometers. But in business we need yardsticks, too: Sets of standards to measure not only tangibles but intangibles—like ideas. Some of these yardsticks will at first be hand-me-downs from a superior. You will acquire many more through diligent application of common sense and technical knowledge. How well you apply them will largely determine your future success. Here's the case of a fellow who used no yardstick for his job.

Part of my work consists of explaining the value of advertising in our publication. On a recent trip I discussed this with a division advertising manager of a well-known corporation. Each sales point produced a negative response. What surprised me was this buyer's disparagement of all trade-accepted methods of evaluating magazine advertising—of any sort. With some irritation I finally told him that my position was of dual character: An executive in the office, and a salesman on the road. As a buyer I found yardsticks prerequisite to intelligent purchasing. Then, quite pointedly, I inquired of him: "Just *what* yardstick do you use in measuring advertising value?" His evasive answer was a convincing admission that he had none and that when compelled to make a decision he did so in much the manner used by Ulysses when he consulted the oracles.

The ranking officer of this company is a Cornellian, and he wouldn't consider this publicity flattering. As for Mr. A. M. - - until he learns the importance of having a set of standards to apply to the buying his job entails, he is likely to go about as far as the lathe operator sans calipers.

All jobs require decisions. The difference between the apprentice, the junior executive, and the senior executive rests largely in the fact that through experience the latter has learned more and better yardsticks to apply to problems requiring decisions. Thus, intelligent application of multiple yardsticks builds up to that all-important ingredient of business success—judgment. (Grandma usually had that, too!)

Robert M. Smith
(Pinch-hitting for Bill Littlewood)

Alumni News

Hoxie H. Thompson, C.E. '05, is a member of the Public Safety Commission of Texas, which, incidentally, is in charge of the famous Texas Rangers. His address is 920 City National Bank Building, Houston, Texas.

Benjamin M. Herr, M.E. '06 of Brier Cliff Road, Pittsburgh, Pa., is owner of Herr-Harris Co. His first assistant is his son, **Benjamin M. Herr, Jr. A.B. '39.**

Henry A. Travers, EE '06, Westinghouse Electric Corporation consultant, retired after 43 years' service with that Company. After doing considerable engineering work on d-c calculating boards, he developed the first a-c calculating board for Westinghouse in 1929. In 1941 he received the Westinghouse Order of Merit "for his outstanding ability as a relay and system analyst engineer and for his pioneering work in the development of the network calculator." A member of the AIEE, he has been granted more than fifteen patents on relays, circuit breakers, and electrical components for calculating boards and in addition has written many papers and magazine articles on switching and system operating problems.

W. H. Robb

Ford Kurtz, C.E. '07, was recently elected vice-president in charge of engineering for the J. G. White Engineering Corp. He is also a director of the company and since 1940 has served as engineering manager and chief hydraulic engineer.

William G. Christy, M.E. '11, smoke abatement engineer for Hudson County, N. J., and consulting engineer on air pollution control, has just completed a year's term as president of the Smoke Prevention Association of America. He was recently elected an alumni member of Tau Beta Pi, Lafayette College Chapter, Easton, Pa., with the consent of the Cornell Chapter; and has been appointed chairman of the engineers registration committee of the ASME.

Max J. L. Schulte, M.E. '15, has moved to Gilbertsville and represents Ellis W. Morse Co., Binghamton, N. Y., steam and mill suppliers, in an extensive area which includes Ithaca and Elmira.

H. W. Robb, E.E. '23, was recently appointed assistant manager of the Standards Division of the General Electric Company's Executive Department. He is also chairman of several committees of the American Standards Association, having served as an advisor to the American delegation attending the Ottowa conference for the standardization of the screw thread in Britain, Canada, and the United States.

Arsham Amirikian, C.E. '23, Head Engineer of the Welding and Special Structures section of the Navy Bureau of Yards and Docks, has been awarded the Lincoln Gold Medal of the American Welding Society for a paper "representing the greatest contribution to the advancement and use of welding in 1949." His prize-winning paper, entitled "Future Developments in Welded Steel Buildings", featured a discussion of a new type of articulated wedge beam framing.

In addition to the recently awarded Gold Medal, he holds the Fuertes Graduate Medal of Cornell University and the First Grand Award and the First Divisional

A. Amirikian

Award of the J. F. Lincoln Arc Welding Foundation. A member of numerous civil and military engineering societies, he was recently honored by membership in the Washington Academy of Sciences for his many contributions to the techniques of design and construction.

Warren R. Bradlee, C.E. '28, has returned to the New York office of Ford, Bacon & Davis, Inc., engineers, after eight months as assistant design engineer and ten months as general superintendent on construction of Argonne National Laboratory for the University of Chicago and the Atomic Energy Commission. He lives at 45 Valleywood Road, Cos Club, Conn.

John W. Todd, Jr., M.E. '35, was recently appointed assistant manager of sales in the alloy division of Carnegie-Illinois Steel Corp., US Steel Corp. subsidiary with general offices in the Carnegie Building, Pittsburgh, 30, Pa.

(*Continued on page* 34)

Techni-Briefs

Surgical Radio Receiver

A tiny radio receiver which can be placed beneath a dog's skin surgically has been developed for use by medical scientists in nerve stimulation experiments. Minute insulated wires run from the receiver, about the size of a ping-pong ball, to whatever nerve is being stimulated. The receiver picks up the radio impulses which are transmitted to the nerve.

The surgery involved is performed while the dog is anesthetized, and the experiments are painless, it was pointed out. The incision soon heals, leaving the dog normal in every respect, save for having a radio receiver under his coat.

Most nerve stimulation experiments in the past have necessitated electrical connections running through incisions in the dog's skin and into the nerve. The new apparatus transmits the stimuli by radio waves, making connections unnecessary. For experiments, the dog is placed in a large cage, which is connected to a radio transmitter. When a nerve is to be stimulated, a signal is sent from the cage to the receiver.

The unique radio application is said to make possible the study of nerve reactions to stimuli with the laboratory animal in a normal physiological state. Other stimulation experiments have necessarily been performed with the dog under anesthetic, with the nerve laid bare, or with electrical leads running through his skin. In every case, the dog has been in an abnormal state, which would have an effect on the scientists' findings.

The receiver is spherical, inclosed in a plastic substance which is not irritating. The wire running to the nerve is also inclosed in plastic, and is connected to the nerve by a small silver foil electrode, which fits sleeve-fashion around a section of the nerve.

This tiny radio receiver may be placed surgically under an animal's skin for physiological experiments.

—Courtesy General Electric

The cage used in experiments is a large coil, ten feet in diameter, connected to a transmitter. A dog can wander around the cage at will, and receive stimuli anywhere in it.

Underground Fire

The progress of one of the largest man-made fires in history is being followed by means of capsules of mercury and an electronic mercury vapor detector.

The fire, started intentionally last March, is in the Alabama Power Company's Gorgas Mine, where experiments in producing gas by igniting a coal vein underground are being conducted by the United States Bureau of Mines and the Southern Research Institute. Small capsules of mercury have been placed at regular intervals through the vein.

A mercury vapor detector, developed by General Electric engineers, constantly "watches" the gases pouring from the mine. When the fire, which may create temperatures as high as 3,000 degrees Fahrenheit, reaches a capsule, the mercury is vaporized. The instrument detects this fact.

In the invention use is made of the fact that ultra-violet light is scattered when it passes through an atmosphere containing mercury vapor. Gases to be tested are passed through a tube between an ultra-violet light source and a photoelectric cell. If the gases contain mercury vapor, less light reaches the cell and the instrument reading changes.

The detector is not affected by carbon monoxide or hydrocarbons produced by the subterranean inferno.

Ultra-violet Microscope

Designed primarily for cancer research, an ultra-violet microscope for observing living, unstained body tissues is now in production at Bausch & Lomb Optical Company.

The instrument's revolutionary objectives not only provide increased resolving power but make it possible to photograph as well as view for the first time freshly prepared sections of live tissues and tissue cultures through three different ultra-violet wavelengths. The photographs may also be projected or reproduced on color film through three visual color filters that provide densities, contrast and structural detail never before attained.

Developed during the past two years by Bausch & Lomb Optical Company, Rochester, N. Y., and Polaroid Corporation, of Cambridge, Mass., the microscope's objectives are of a reflecting type, and therefore corrected chromatically throughout the entire ultra-violet and visible spectrum. Focusing can be done in visible light and photographs taken with other regions of the spectrum wthout disturbing the focal setting.

(*Continued on page* 20)

Coming cleaner

SUCH QUICK EASY CLEANING . . . practically no scrubbing . . . no fading of colors . . . no irritation for tender skins—sounds like a new and better soap, doesn't it? But it isn't soap at all!

Now you can have a *modern* cleaner that removes dirt with unbelievable speed, yet is completely mild to the skin and to the sheerest fabrics. Modern cleaners carry the dirt away with them, and form no ring in the dishpan or tub.

These new cleaners are made from organic chemicals. They are scientifically prepared to work equally well in soft, hard, even salt water.

For washing dishes or clothes, for housecleaning, for industrial uses, better cleaners are here right now—and they are improving every day.

Today's modern synthetic detergents are not soaps . . . they are entirely different chemically, and work in a different manner.

The people of Union Carbide have a hand in making many of the organic chemicals that go into these modern, efficient cleaners. Producing better materials for science and industry—to aid in meeting the demand for better things and better performance—is the work of Union Carbide.

FREE: *If you would like to know more about many of the things you use every day, send for the illustrated booklet "Products and Processes." It tells how science and industry use UCC's Alloys, Chemicals, Carbons, Gases, and Plastics. Write for free Booklet A.*

UNION CARBIDE
AND CARBON CORPORATION
30 EAST 42ND STREET UCC NEW YORK 17, N. Y.

Trade-marked Products of Divisions and Units include

SYNTHETIC ORGANIC CHEMICALS • LINDE Oxygen • BAKELITE, KRENE, and VINYLITE Plastics
PREST-O-LITE Acetylene • PYROFAX Gas • NATIONAL Carbons • EVEREADY Flashlights and Batteries
ACHESON Electrodes • PRESTONE and TREK Anti-Freezes • ELECTROMET Alloys and Metals • HAYNES STELLITE Alloys

Techni-Briefs

(*Continued from page* 18)

By using a band of wavelengths, intensity of illumination in the microscope is high, allowing shorter photographic exposure than is required in a monochromatic objective system.

Subtle changes in the balance of certain biochemicals within the living cell, which may, for example, be linked to carcinogenesis, may also be determined by measuring the ultra-violet transmission of individual cell parts at different wavelengths of light.

Now in use at the Sloan Kettering Institute for Cancer Research and Massachusetts Institute of Technology, the microscope is particularly useful in the field of biochemistry for direct photographic recording of biological tissues, for microphotometric determination of biochemicals by photoelectric means or for photodensitometry.

Slices less than two-millionths of an inch thick can be made with this recently developed microtome.

—Courtesy General Electric

Slicing Device

A new "slicing device", utilizing shock waves, has just been developed by Dr. E. F. Fullam; with the new technique, slices of metal less than two-millionths of an inch thick may be made, thinner than any ever before made by man.

The apparatus of the device, called a "high-speed microtome", consists of a delicately-balanced metal wheel, three and three-eighths inches in diameter, spun at 65,000 revolutions per minute by a three-horsepower electric motor. Projecting one-half inch beyond the wheel's edge is a small steel blade, which is driven through the air at speeds up to 750 miles per hour. A screw device feeds the specimen, usually embedded in wax, into the path of the knife. According to Dr. Fullam, the shock-wave in the sample makes the slice before the blade itself can cut, and the blade's sharpness is not of primary importance.

The new technique will find wide application in preparing specimens for electron microscopy, which requires samples sliced to a fraction of the 39-millionths of an inch thickness required by ordinary light microscope specimens.

Graphecon

The fleeting image from a radar scope can be retained and intensified by a new electron tube that introduces for the first time a material that is being used as both an insulator and an electrical conductor.

This tube, the Graphecon, is a "booster" device that is employed between the stage where the radar beam is received and where it is reproduced on a television kinescope. It has "visual memory," and retains for more than a minute images that otherwise would have a life of less than one millionth of a second.

The first major application of the Graphecon is expected to be in Teleran, the air navigation aid, in which a composite televison picture comprising radar pattern, its associated ground map and other information are transmitted from ground to plane. This all-electronic converting scheme, since it "stores," with very slow deterioration, signals which otherwise fade rapidly, makes it possible to transmit a much stronger picture to the pilot-viewer, whose life may depend on the safe landing the information enables him to make.

Of equal importance is the fact that radar signals, in the form of electricity rather than light, can be amplified. The image that appears on the fluorescent surface of a radar scope is so dim that it cannot be telecast without the use of complicated optical booster systems. With the Graphecon, the radar pattern is kept in the form of an electrical charge, which may be readily amplified, until it reaches the kinescope.

The greatly increased level of kinescope brightness will make it possible for search radar monitors to observe the radar pattern in normally lighted rooms and without the long and frequently nerve-wrecking periods of light-accommodation.

Traces from the cathode ray oscilloscope, which occur in intervals so short they are measured in millionths of seconds, may also be retained for scrutiny or reproduction.

Atomic Applications

Though scientists see no early prospects of an atomic energy powered automobile, products of the atomic pile are finding wide application in various phases of automotive research.

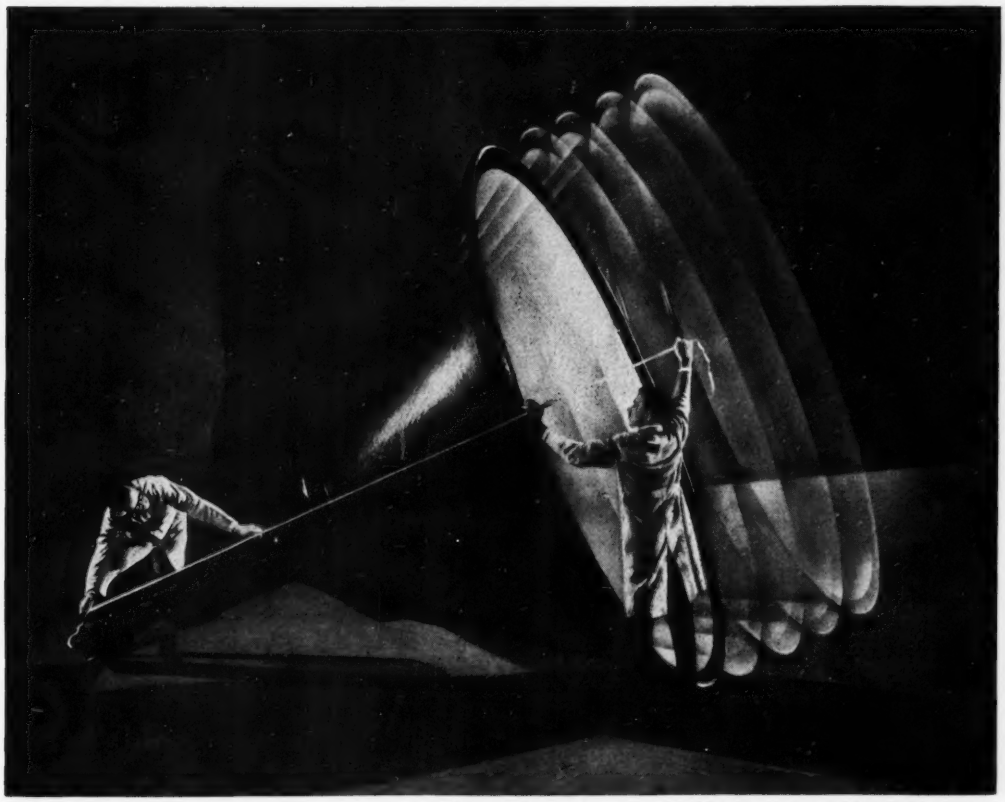
It is now possible to examine thick sections of metals with the isotopes of Cobalt 60, a radioactive metal that possesses penetrating power comparable to a two million volt X-ray machine. This allows for the radiography of a wide range of materials and thicknesses.

One important use is to make periodic checks of welds in high pressure steam lines in the company's plants. The condition of each weld is recorded on X-ray film. Any defective welds are easily detected and repaired.

Most of the research uses are tracer techniques. A small quantity of isotopes is introduced into the material or process under investigation, and various changes are observed with Geiger counter equipment.

Piston rings and other motor parts have been made radioactive for use in friction studies. Recently radioactive rings were installed in a test engine, which was allowed to run a few hours, then a sample of oil was taken from the engine's crankcase. The radioactive particles which had worn off of the rings were measured by a Geiger counter. The amount of wear was measured to as close as a millionth of an ounce of metal.

(*Concluded on page* 32)



New and shorter big screen 16-inch kinescope developed by RCA scientists.

Problem: shrink the television tube, but keep the picture ***big!***

Some rooms accommodate grand pianos; a small spinet is right for others. Until *recently*, much the same rule held true for television receivers. Your choice of screen sizes was largely governed by room space.

Now the space problem has been whipped by RCA scientists, who have *shortened the length of 16-inch television "picture tubes" more than 20%!* All the complex inner works—such as the sensitive electron gun that "paints" pictures on the screen—have been redesigned to operate at shorter focus, wider angle. Even a new type of faceplate glass, Filterglass, has been developed for RCA's 16-inch picture tubes—on principles first investigated for television by RCA.

Filterglass, incorporating a light-absorbing material, improves picture quality by cutting down reflected room light . . . and by reducing reflections inside the glass faceplate of the kinescope tube itself. Result: richer, deeper black areas and greater contrast in the television picture!

* * *

See the newest advances in radio, television, and electronics in action at RCA Exhibition Hall, 36 West 49th St., New York. Admission is free. Radio Corporation of America, Radio City, N. Y.

Continue your education with pay—at RCA

Graduate Electrical Engineers: RCA Victor—one of the world's foremost manufacturers of radio and electronic products—offers you opportunity to gain valuable, well-rounded training and experience at a good salary with opportunities for advancement. Here are only five of the many projects which offer unusual promise:

- Development and design of radio receivers (including broadcast, short wave and FM circuits, television, and phonograph combinations).
- Advanced development and design of AM and FM broadcast transmitters, R-F induction heating, mobile communications equipment, relay systems.
- Design of component parts such as coils, loudspeakers, capacitors.
- Development and design of new recording and producing methods.
- Design of receiving, power, cathode ray, gas and photo tubes.

Write today to National Recruiting Division, RCA Victor, Camden, New Jersey.

Also many opportunities for Mechanical and Chemical Engineers and Physicists.

RADIO CORPORATION of AMERICA

World Leader in Radio—First in Television

Engineering Book Reviews

WATER SUPPLY ENGINEERING. *By Harold E. Babbit and James J. Doland. Fourth Ed. 637 pp. McGraw-Hill Book Co. Inc., New York.* 1949. $6.50.

Many instructors in the field of water supply and water treatment engineering have felt the need for a textbook that would be satisfactory for a course aimed at presenting a rational approach to the design of the structures, based on a sound understanding, on the part of the student, of the fundamental principles underlying the function of the structure. The continuing lack of such texts suitable for use as a source of reading material to supplement instruction in the classroom applies with equal force to numerous other fields of applied engineering.

The reason for this situation probably lies in the fact that too many of the texts in applied engineering represent an attempt to meet the requirements of a group too heterogenous in nature and too diverse in background interests and needs to be met by any single text. In all these respects the student being introduced to a subject, and the practicing engineer are poles apart. This combination of objectives, with its attendant profusion of descriptive material, does not lighten the task of the student seeking out principles. More serious is the charge that the use of such texts tends to perpetuate a cycle in which students, instructed in the empirical methods of "practical" engineers, develop, in turn, into a next generation of "practical" engineers. The best chance of breaking this cycle lies in the schools with their responsibility for encouraging and developing in the student a rational approach to engineering design. In this task the instructors must rely on at least a certain amount of assistance from published material.

The fourth edition of the widely used Babbitt and Doland "Water Supply Engineering" does not depart from the pattern of the "dual objective" texts mentioned above. It is however the most complete and up-to-date presentation of water supply and treatment subjects currently available. Several chapters have been completely rewritten, several have been added. The usual subjects are treated, some in greater detail than would be warranted in a text written solely for students, others are not adequately treated. The fact that the Hazen-Williams formula may be commonly and widely used does not justify the emphasis placed on the use of an equation now discredited in many quarters. Additional material on the design of long pipe lines and of impounding reservoirs would be desirable. The treatment of the Hardy-Cross method of analysis is unnecessarily confusing to the student. The discussion of the bacteriological analysis of water is extremely limited in view of its relative importance. The theory of the coagulation of water is unfortunately omitted. Sand infiltration, water softening, disinfection, miscellaneous methods of water treatment all are adequately treated. Particularly helpful is the inclusion of a very complete list of references, conveniently placed at the bottom of the pages. A considerable number of problems is also included in an appendix.

The authors have presented a very considerable amount of valuable, pertinent and up-to-date material. The approach and presentation which are in general empirical rather than rational in nature, do not however meet the requirements of the beginning student seeking the underlying principles and functions on which to base sound engineering design.

Charles D. Gates,
Assoc. Professor of Sanitary Engineering.

APPLIED HYDROLOGY *by Ray K. Linsley, Jr., Max A. Kohler, and Joseph L. H. Paulhus.* 700 *pp.; McGraw-Hill Book Co., Inc., New York.* 1949. $8.50.

Webster's definition of hydrology appears to be the authors' starting point in the writing of this book. After briefly presenting the hydologic cycle, the authors draw upon climatology and meteorology in discussing the various factors affecting the occurrence, distribution, and movement of moisture in the atmosphere.

The traditional exposition of the methods of measurement of precipitation and stream flow and the analysis of such data is supplemented by many of the newer techniques of analysis of the data. The Depth-Area-Duration analysis of rainfall data is typical of the more recent techniques.

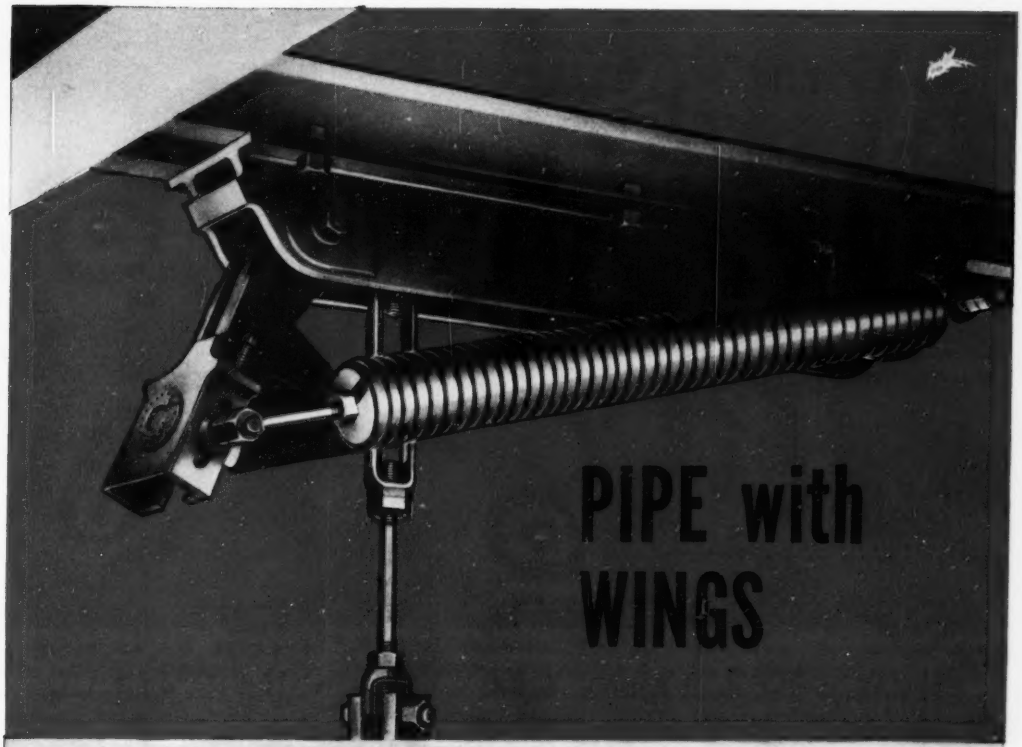
A discussion of the effect of the geological, topographical, and botanical characteristics of the watershed upon stream flow provides a rational approach to the complicated problem of determining stream flows from watersheds for which stream flow records are lacking. This discussion includes the concept of infiltration analysis, several methods of statistical correlation of the pertinent variables, and some empirical relationships.

Sedimentation and Erosion Problems Covered

The authors depart from the narrow concept of hydrology in the presentation of chapters on sedimentation and erosion in stream channels, sedimentation in reservoirs, waves, stream flow routing, and forecasting of river stages. This departure is desirable because the phenomona of erosion and sedimentation are closely related to many hydrologic problems. The prediction of stream flow at points on a stream which are a distance from gaging stations is based upon a knowledge of the mechanics of waves and the methods used in stream flow routing.

Potential users of this book include students, practicing engineers and new research workers. The basic fundamentals approach to the

(*Concluded on page* 30)



TONS of high pressure, high temperature piping in a power plant must "float" . . . or something busts. In a power station now under construction the main steam lines carry steam at 1,050 degrees temperature and 1,500 pounds pressure, and travel as much as 7⅝ inches vertically and 5 inches horizontally. If this expansion were to crowd back into any part of the power equipment, the strain would be disastrous.

At every point of its travel from cold to hot positions, this piping must have the same amount of support or "lift" so that none of the stress will be transferred along through the piping system. That's an engineering problem for which there's only one practical solution . . . what amounts to "wings for pipe". It's a constant-support pipe hanger, made only by Grinnell, which provides supporting force equal to the weight of the shifting pipe in all positions.

The solution to this complicated problem of thermal movement is typical of Grinnell's complete piping service, which provides the products, facilities and experience required "whenever piping is involved". Grinnell Company, Inc., Providence, R. I.

»»» This is the largest Grinnell Constant-Support Hanger made. It is over 6 feet long and will handle vertical piping travel up to 8 inches and weights up to 22,000 pounds. Each of these mammoth hangers in this new power plant will support tons of chrome molybdenum alloy steel pipe with an outside diameter of 14 inches and a wall thickness of 2 inches through a maximum travel of 7⅝ inches vertically and 5 inches horizontally.

GRINNELL

ENGINEERING GRADUATES HAVE FOUND ATTRACTIVE OPPORTUNITIES WITH GRINNELL

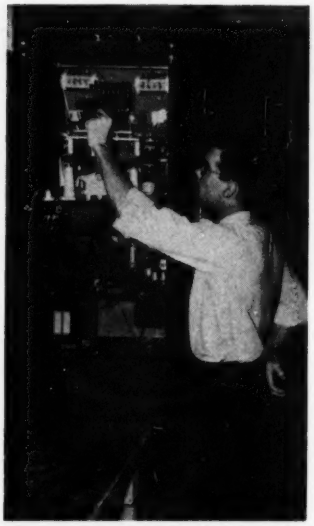
Cornell Amateur Radio Club

After a lapse of some thirty years, organized ham activity is back on the Cornell campus. About a year ago, a group of hams got together with Colonel Victor Warren, the ROTC Signal Officer, and formed the Cornell Amateur Radio Club.

The ROTC organization gave the club two rooms in the north tower of Barton Hall. The club's shack, or operational room, is on the level of the balcony. In this room are housed the sending and receiving equipment, the club's library and the shop benches and tools. The members have been working at a feverish pace so as to be able to begin operations this term. Near the top of the tower is the second room which houses a directional antennae run by a small motor controlled from the shack.

The kilowatt transmitter the club possesses is on loan from the EE school which used it during the war in its military training program. Last year the set was redesigned and rebuilt as a term project.

Two call letters have been assigned to the club by the FCC. The first, W 2 CXM, is for general use of the members and is the one that will be most frequently used. The other is K 2 WAG and was assigned by the Military Amateur Radio System for use by the members who are either in any Armed Forces Reserve Program or are taking ROTC. Membership in MARS, in addition to giving reserve point credits to reservists, may bring the club equipment from Signal Corps surplus stocks.



Ken Bowles makes final adjustments on the Ham Club's kilowatt transmitter.

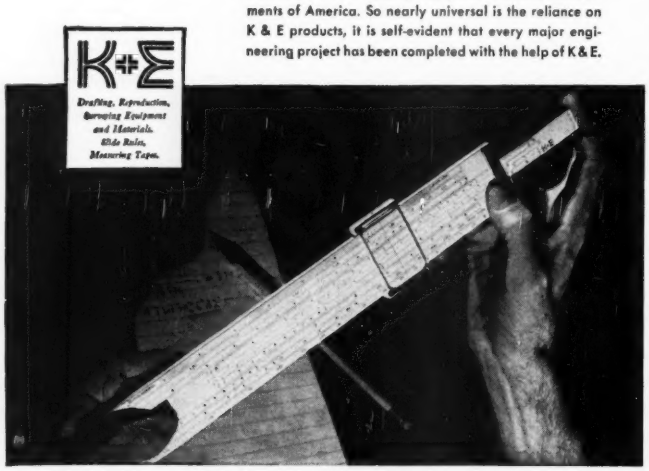
In addition to its operational activities, the club has a training school in operation for those who want to take the FCC examination. The first program began a month before Christmas and was eight weeks long. Meetings are held each week and each meeting consists of two hours of electrical and radio theory and a third hour spent in code work. Signal Corps field telegraph sets are used for code practice. The problems facing the instructors are unique in that in the same class are senior EEs, junior MEs and freshmen Ag students. At the end of the training course, it is hoped to have an FCC inspector come to Ithaca and test the group as a whole. Lecture notes for the classes and a monthly news letter for members are published.

Officers of the club chosen at the last election were: Claude A. R. Kagan, W 2 UUI, president; Ken Bowles, W 2 KQW, vice-president; Dick Seifert, W 2 UZG, secretary; and Dave Zammat, W 2 WAL, treasurer. The letters following the names are the call letters of the officers of the club.

When operations are begun in the near future, the voice of Cornell should be able to be heard around the world. If you have a receiving set, try and pick it up.

partners in creating

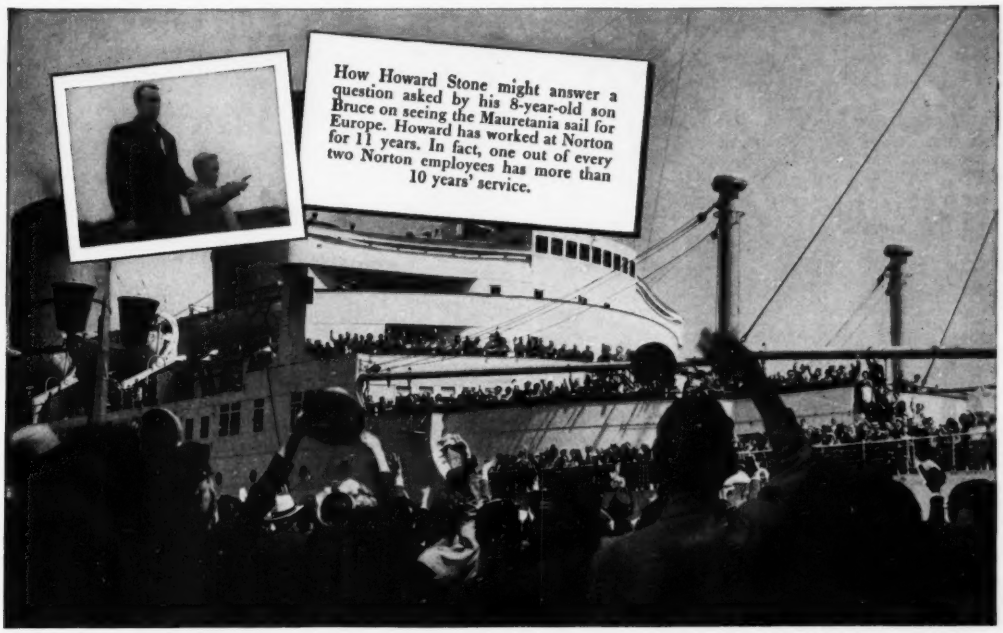
Engineering leaders for the last 81 years have made K & E instruments, drafting equipment and materials their partners in creating the great technical achievements of America. So nearly universal is the reliance on K & E products, it is self-evident that every major engineering project has been completed with the help of K & E.



KEUFFEL & ESSER CO.

EST. 1867

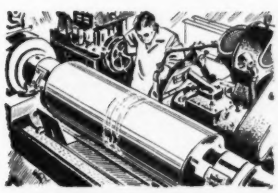
NEW YORK • HOBOKEN, N. J.
Chicago • St. Louis • Detroit
San Francisco • Los Angeles • Montreal



How Howard Stone might answer a question asked by his 8-year-old son Bruce on seeing the Mauretania sail for Europe. Howard has worked at Norton for 11 years. In fact, one out of every two Norton employees has more than 10 years' service.

"HOW BIG DO THEY MAKE SHIPS, DAD?"

"Almost no limit, son, as long as the men who design and build them continue to take advantage of scientific progress in all the things that make ships strong, fast and safe.



"Things like the ship's steel plates. They must be just right. That's why the powerful rolls that form them in steel mills are kept smooth and true with big Norton roll grinders and fast-cutting Norton grinding wheels.

"To give today's floating cities extra speed and smoother sailing, propellers must have perfect surfaces... the kind that come from rough-grinding with Norton cup-shaped wheels and finishing with Behr-Manning abrasive discs.

"Yes, and attention to fine details is the sign of the wise ship designer. That's why the terrazzo floors in galleys of ships like the 'Queen Mary' get lasting, non-slip safety from a Norton product called Alundum aggregate."

"So, you see, Bruce, in these ways and many more Norton has a hand in making modern ships bigger and better... another proof that I'm not boasting when I say 'Norton makes better products to make other products better'."

NORTON

TRADE MARK REG. U. S. PAT. OFF.

Making better products to make other products better

ABRASIVES · GRINDING WHEELS · OILSTONES · ABRASIVE PAPER & CLOTH

GRINDING AND LAPPING MACHINES · LABELING MACHINES · NON-SLIP FLOORING

REFRACTORIES, POROUS MEDIUMS & LABORATORY WARE · NORBIDE PRODUCTS

NORTON COMPANY, WORCESTER 6, MASSACHUSETTS

BEHR-MANNING, TROY, N. Y. IS A DIVISION OF NORTON COMPANY

Got a problem?
NE has the Answer!
You won't need a slide rule or transit when it comes to locating a single source for electrical roughing-in materials. Just look to NATIONAL ELECTRIC for the complete answer. There's a National Electric product to fill every wiring need. The complete NE line of electrical roughing-in materials includes: CONDUIT . . . CABLE . . . WIRE . . . RACEWAYS . . . FITTINGS.
NATIONAL ELECTRIC PRODUCTS
NE
WIRING SYSTEMS
WIRES AND CABLES
National Electric
PRODUCTS CORPORATION
PITTSBURGH 30, PA.

A HALLMARK CARD

THIS IMPRINT ON THE BACK OF THE GREETING CARDS YOU SEND IS YOUR ASSURANCE OF FINEST QUALITY

Cards for every occasion are on display at

TRIANGLE BOOK CO-OP

Evan J. Morris, Proprietor

412 College Avenue Sheldon Court

College News

(*Continued from page* 14)

School of Mechanical Engineering, Professor M. W. Sampson is teaching a one-hour course in Technical Report Writing to a small group. Professor Sampson is much concerned that the young engineer should be able to express himself clearly and concisely; he emphasizes that in a large industrial organization, the only impression that top management may have of the cub engineer is the periodic progress report he submits. Hence, his ability to write well may have as much bearing on his success as personality or engineering know-how. The course includes weekly written assignments designed to give the student practice in expressing ideas and experimental results clearly and completely, without wordiness.

Engineering Economics

In the School of Chemical and Metallurgical Engineering, a recently appointed faculty member, Professor J. E. Hedrick, will give a three-hour course in chemical engineering economics. Economic factors of special significance in the chemical industries will be discussed, filling a long-acknowledged gap in the chemical engineering curriculum. The economics of purchasing, marketing, research, and process development are among the topics outlined for the course.

Student Suggestions

An announcement in the aperiodic Olin News urged students in the School of Chemical and Metallurgical Engineering to put their occasional criticisms of teaching methods in writing and submit them to the Director of the School. Since all such statements are to be held strictly confidential by the Director, it was requested that they be signed and in writing in the belief that in this way opinions that are more carefully considered and clearly expressed can be obtained. It was explained that by criticism is meant both favorable and unfavorable comments, since it is of significant interest that well-taught, as well as poorly-taught courses be recognized. Letter form rather than the familiar questionnaire is suggested to allow the student more leeway in describing the merits of a particular course. Defects in teaching methods, it was suggested, arise most frequently from the instructor's failure to appreciate the difficulties experienced by the student, rather than from a lack of interest or knowledge on the part of the instructor. The criticisms were solicited in order that the instruction that the student pays for in time, money, and effort may be as good as it is possible to get.

Reappointments

Six members of the staff of Cornell University have been reappointed members of technical subcommittees of the National Advisory Committee for Aeronautics. They are: Dr. Theodore P. Wright,

(*Continued on page* 28)

"Where opportunity knocks every day"

This huge new building pictured above is one of the world's most modern petroleum research laboratories—those of the Standard Oil Development Company at Linden, N. J. It is the research center where Esso Products are constantly developed and improved by engineers and technicians whose aim is better products for better living all over the world.

Here chemists and engineers find limitless opportunities for the scientific advancement of petroleum research. Scientific exploration in all the phases of oil production is constantly encouraged at Esso.

The 28,000 workers at Esso have been with the company an average of 13 years... 8,700 of them for 20 years or more. Esso is proud to have this large number of "career employees," enjoying fair pay, good working conditions, and a chance to learn more about the oil business and to advance in the company.

It has been an Esso Management policy for more than 30 years to keep *good people* happy at *good jobs*... and turn out consistently *good products* that carry the Esso trademark.

ESSO

ESSO STANDARD OIL COMPANY

It Gulped Up Whalebones!

Uncovered a Sunken Wreck!!

Exciting Saga of Gibson & Cushman's

MORRIS 15" DREDGE

1 AT OCEAN BEACH, L. I. . . . the "No. 15" started dredging on a beach restoring job November 1946. But it was tough going! There were large bone portions of whale vertebrae which sometimes measured 18" x 6" x 6". These proved to be of considerable geological interest and are being preserved. Despite obstacles, however, the "No. 15" averaged 350 yds. per hour; at times it pumped 540 yds. per hour. Pipe lines varied from 2300 ft. to 5000 ft. On this job, the "No. 15" pumped 130,000 yds. in 3 weeks and 1 day!

2 AT GILGO BEACH, L. I. . . . the Dredge "No. 15" started building a sand dune parallel to ocean shore. Though the material was troublesome at times (sunken wreck and layers of clay) the average output over a considerable period of time was 500 yards per hour. Longest pipeline was 6300 feet.

3 AT ZACHS BAY, JONES BEACH, L. I. . . . the Dredge moved a total yardage of approximately 110,000 cu. yds. for beach restoration. The "No. 15" is a 15" dredge . . . Morris Engineers had a major part in its design and building. She is owned by Gibson and Cushman, Bayshore, Long Island, N. Y., well known Dredging Contractors. Pump is directly connected to 8 cylinder 12" bore, 15" stroke Diesel engine, developing 610 BHP at a speed of 475 RPM.

FREE SERVICE . . . For more than 80 years, Morris Engineers have been designing and building hydraulic machinery for every type of dredging operation. Write today for a free copy of Bulletin 177 . . . or ask for information concerning your particular dredging requirements.

MORRIS MACHINE WORKS
Baldwinville, N. Y.
Sales Offices in Principal Cities
John C. Meyers, Jr., E.E., '44, Executive Vice-Pres.

MORRIS CENTRIFUGAL PUMPS

College News

(*Continued from page 26*)

chairman of the committee on Aerodynamics; Dr. C. C. Furnas committee on Aircraft Construction; Prof. C. W. Gartlein, special subcommittee on the upper atmosphere; W. F. Milliken, subcommittee on stability and control; Dr. William R. Sears, Subcommittee on Fluid Mechanics; and Clem G. Trimbach, subcommittee on aircraft fire prevention. Members of the NACA's 27 technical committees serve in a personal and professional capacity without compensation in contributing their knowledge in their special fields toward formulation of research programs required for this country's air leadership.

Engineering Council

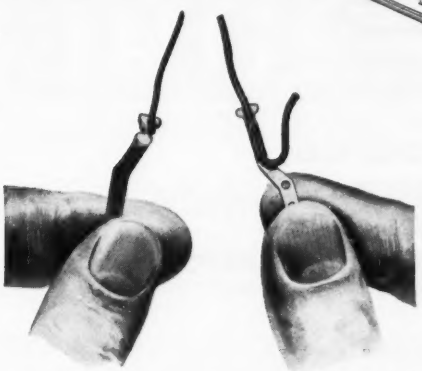
Representation for engineers on the Student Council has been won by the Cornell Student Engineering Council, the student organization of the Engineering College. Backed by a vote of confidence of almost twice the 500 votes required, the CSEC was voted into the Student Council on February 23. The engineers' representative will be the president of the CSEC, Alfred Blumstein, EP '51.

The CSEC obtained its seat by virtue of a clause in the Student Council constitution which states that the student organization of a college may have a voting seat on the Student Council if it can prove that it is the unique representative organization of the college. This the CSEC did on February 16, when it received over 900 ballots from engineers indicating their desire to have the Engineering Council represent them. Thus, the CSEC joins the Ag-Domecon Council, and the I.&L.R. School and the Hotel School organizations as the fourth such group to have a seat on the Student Council.

The Engineering Council was organized in the fall of 1948, and has been functioning very successfully ever since. It is composed of two representatives elected by each of the professional societies in the schools of the College. The Engineers' Day it sponsored last year was particularly popular, and promises to be even more this year. (See the April issue of the ENGINEER for

(*Concluded on page 30*)

Newsworthy Notes for Engineers



What's the difference?

$2,500,000 a year!

Both hands hold terminations used in telephone dial switching equipment. They look pretty much alike – but let's see about that!

The termination at left is made by the old method. Insulation is stripped off the wire. The wire is twisted around the brass terminal, then fastened to it with a soldering iron. That had to be done on millions and millions of connections each year.

The termination at right is made by a new machine process developed by engineers at Western Electric–manufacturing unit of the Bell System. One type of machine separates the brass connectors from a "strip" and accurately positions each on an insulator to which groups of 10 are fastened by eyeleting. Another machine places 20 wires in the proper position on two sets of 10 connectors, drives two small pyramidal shaped points through the insulation into the wire and crimps the brass around the wire, making a good, solid electrical connection. The whole job now is done in one-tenth the time.

This improvement will add $2,500,000 a year to the vast amount Western Electric engineers are saving the Bell Telephone System through manufacturing economies. Year after year they look for – and *find* – ways to make telephone equipment better and at lower cost. Their savings help Bell Telephone companies to keep rates as low as they are.

This machine, developed by Western Electric engineers, assembles dial switching terminations automatically at the rate of 400 per minute.

Western Electric

A UNIT OF THE BELL SYSTEM SINCE 1882

Engineering problems *are many and varied at Western Electric, where manufacturing telephone equipment for the Bell System is the primary job. Engineers of many kinds—electrical, mechanical, industrial, chemical, metallurgical—are constantly working to devise and improve machines and processes for production of highest quality communications equipment.*

LAVA

Manufacturers of Super-Refractories Only

•

REFRACTORY CRUCIBLES
GRAPHITE CRUCIBLES
HIGH-TEMPERATURE CEMENTS
SPECIAL REFRACTORY BRICK, TILE, SHAPES

•

From the Following Materials:—

GRAPHITE SILICON CARBIDE FUSED ALUMINA MULLITE
MAGNESIA ZIRCON

•

LAVA CRUCIBLE COMPANY of PITTSBURGH
Pittsburgh, Pennsylvania

Use the CORNELL UNIVERSITY PLACEMENT SERVICE

Administration Building, Ithaca
John L. Munschauer '40, Director

New York Office, 107 E. 48th St.
Paul O. Reyneau '13, Manager

College News

(*Continued from page* 28)

some more information on this year's show.) Some of the other projects they initiated were the annual engineers' dance, the "Slide Rule Capers"; presentation of speakers on topic of interest to all engineers; and the publication of the *Engineering Council Notes*, to coordinate the activities of the various student engineering groups.

Professor Henriksen

Professor Erik K. Henriksen, head of the Materials Processing Department in the College of Engineering at Cornell University, is the author of a study titled "Residual Stresses in Machined Surfaces," which has just been published in Copenhagen. Professor Henriksen came to Cornell from Denmark in 1948. The English-language volume is part of the Transactions of the Danish Academy of Technical Science and is one of only a few studies on the subject.

Professor Winter

Professor George Winter, who is head of the Structures Department in the School of Civil Engineering at Cornell, has been appointed a visiting professor of structural engineering at California Institute of Technology for the spring term. Professor Winter has recently been elected to the U.S. Council of the International Organization for Bridge and Structural Engineering.

Book Reviews

(*Continued from page* 22)

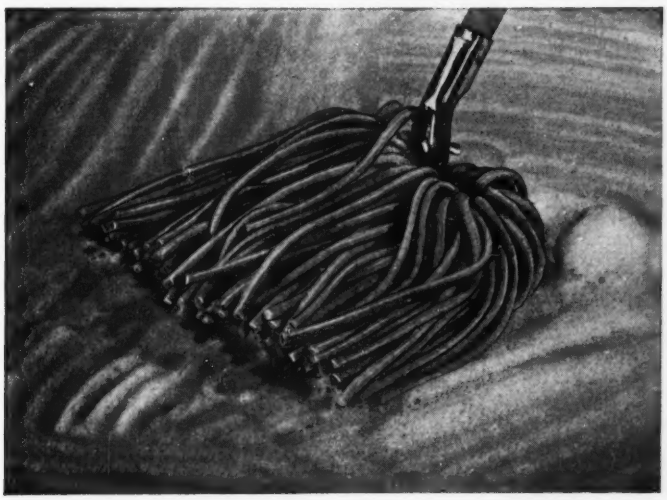
subject is very desirable for classroom use because of the resulting association of new material with subject matter previously studied. The addition of techniques, especially the newer ones, fills a need of practicing engineers. The wide range of material covered gives the embryo research worker a comprehensive picture of the field. The numerous footnotes and references provide starting points for research into several of the specialized branches of the subject.

George B. Lyon
Asst. Professor of Civil Engineering

THE DU PONT DIGEST

Science Makes a Better Mop

Cleaning tasks lightened by new Du Pont cellulose sponge yarn



CROSS-SECTION *of the new mop yarn. Each cotton fiber strand is jacketed with cellulose sponge material.*

An ordinary mop has a bad habit of unraveling. It often leaves a trail of lint. And it wears out fast. A man who sold yarn to mop manufacturers decided to do something about these nuisances. Perhaps some reinforcing material might be combined with the yarn. He did some experimental work of his own but more and more he wondered if it might be possible to use a cellulose sponge coating.

THREE YEARS OF RESEARCH

So the man called on Du Pont, the company that had introduced the cellulose sponge to America in 1936. The suggestion of a sponge yarn presented a challenging problem.

Some way would have to be found to extrude a tightly fitting cellulose sponge jacket around each strand of the yarn. The whole sponge process would have to be adjusted for use in an especially designed machine. Du Pont chemists and engineers tackled these problems.

Even the very first cellulose sponge yarn produced experimentally made mops that were strong, absorbent and durable. But the process had to be changed and improved time and time again. Then the mops were tested in places where they would get the hardest usage—railroad stations, for example.

The mops performed so well that Du Pont built a pilot plant near Buffalo and, under a license from the man who had the original idea, manufactured the yarn on a small scale. Only after three years of study and testing was Du Pont able to offer mop manufacturers the yarn in commercial quantities.

FASTER AND CLEANER

Mops made with cellulose sponge yarn pick up and retain so much water they need wringing less often. You can mop a floor with them in far less time than it formerly took. They dry quickly, leave no lint. They outwear other mops three to five times. Best of all, perhaps, they stay dirt-free longer than ordinary mops. Here is something women will appreciate—a *clean* mop!

The introduction of these new cleaning tools is another example of how business firms of all sizes depend on each other. The Du Pont Company had facilities for specialized research on cellulose sponge. Because Du Pont could supply sponge yarn economically, some twenty mop manufacturers today have a better product that saves maintenance people and the American housewife time, labor and money.

★ ★ ★

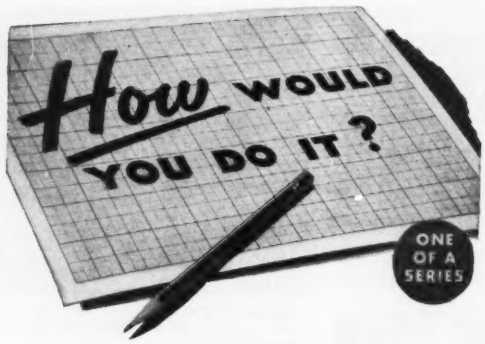
SEND FOR "The Story of Cellulose," a 43-page booklet that tells how wood and cotton are transformed into sponges, textile fibers, lacquers, plastics, coated fabrics, Cellophane and many other useful products. Illustrated with photographs, charts and chemical equations. For free copy, write to the Du Pont Company, 2503 Nemours Bldg., Wilmington 98, Delaware.

DU PONT

REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING
... *THROUGH CHEMISTRY*

Great Dramatic Entertainment—Tune in "Cavalcade of America" Tuesday Nights, NBC Coast to Coast



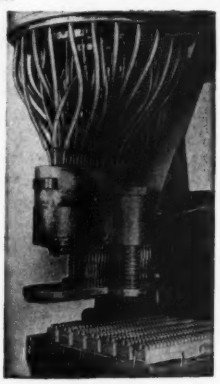
PROBLEM — Your company manufactures gas burners of varying number and spacing of gas ports. You want to develop a drilling machine which can be changed over with a minimum of time and effort to drill the holes in the different burner castings. How would you do it?

THE SIMPLE ANSWER — The illustration shows how one manufacturer solved this problem by using S.S.White flexible shafts as spindles. This arrangement makes possible quick changes of spindle groupings to meet different requirements. As here, S.S.White flexible shafts make ideal power drives for almost any machine part which must be adjustable.

* * *

This is just one of the hundreds of remote control and power drive problems to which S. S. White flexible shafts provide a simple answer. Engineers will find it worthwhile to be familiar with the range and scope of these "*Metal Muscles*"* for mechanical bodies.

* Trade Mark Reg. U. S. Pat. Off. and elsewhere.



WRITE FOR BULLETIN 4501

It gives essential facts and engineering data about flexible shafts and their application. Write for your free copy.

S.S.WHITE INDUSTRIAL DIVISION

THE S. S. WHITE DENTAL MFG. CO. — DEPT. C, 10 EAST 40th ST., NEW YORK 16, N. Y.

FLEXIBLE SHAFTS • FLEXIBLE SHAFT TOOLS • AIRCRAFT ACCESSORIES
SMALL CUTTING AND GRINDING TOOLS • SPECIAL FORMULA RUBBERS
MOLDED INSULATION • PLASTIC SPECIALTIES • CONTRACT PLASTICS MOLDING

One of America's AAAA Industrial Enterprises

Techni-Briefs

(*Continued from page* 20)

Another interesting use of the atomic-age detectors was in ferreting out bootleg gasoline supplies. Along the Texas border recently, a bootleg tetraethyl lead gasoline made its appearance on the market. It was impractical to arrange chemical tests at individual gasoline stations, so inspectors mixed radioactive isotopes with the genuine gasoline at the refinery. By using a radioactive detector, the inspectors then could readily identify the genuine product. Locating the bootleg stuff became merely a matter of elimination.

Teflon

The Du Pont Company has discovered new forms of "Teflon" tetrafluoroethylene resin, one of its outstanding plastics developed during the war. These new forms will enable chemical, electrical and other industries, for the first time, to take full advantage of the material's extreme resistance to chemical corrosion and its ability to withstand high temperature.

The new forms are not yet in commercial production, but their evolution is regarded as being almost as important as the discovery of the plastic—"Teflon" itself. "Teflon" has been difficult to fabricate and heretofore it has been possible, only by slow and costly methods, to make the plastic solely in relatively simple shapes with limited industrial uses.

Out of this new suspensoid form of "Teflon," five new finished product developments have been evolved, which are expected to have considerable industrial usage when sufficient suspensoid becomes available. These five finished products are:

1. Industrial finishes which may be applied with paint-spraying equipment to metals and thus, for example, may be used to give chemical tanks corrosion-resistant linings.
2. Enamels for insulating fine wire which can be coated at a rate of about 50 feet a minute on standard wire-coating machinery, for use in electric motors, transformers, and generators.
3. Compounds for extruding heavier insulation onto wire at rates upward of 20 feet a minute in contrast with the present rate of six feet an hour.
4. Unsupported "Teflon" film of improved quality.
5. Glass fabrics coated with "Teflon."

In addition, the suspensoid is offered by Du Pont as a raw material which will find many other uses.

As an indication of the value of the new forms to the chemical and electrical industries, it was pointed out that the plastic will resist the attack of virtually all chemicals, except molten alkali metals, up to 500 degrees F. Because of its heat-resistance, "Teflon" insulation on electric motors makes it possible to raise their power capacities substantially without increasing their size.

Electronics GLAMOUR GIRL—OR PRODUCTION WORKER?

by H. A. BARTLING
Manager, Electronics Section
General Machinery Division
ALLIS-CHALMERS MANUFACTURING COMPANY
(*Graduate Training Course 1927*)

SO MANY near-miracles, actual, experimental or imaginary, are being attributed to electronics that it's quite the glamour girl of the electrical industry. Working closely with this infant prodigy, we find it is indeed fascinating and astonishingly versatile. We find, too, that it is a terrific worker. Applying electronic principles to tough, matter-of-fact industrial jobs is the work of this section.

H. A. BARTLING

It rewards us with some really amazing success stories, and with abundant opportunity. The field has hardly been touched.

New Field

This field of industrial electronics was completely unknown, of course, when I received my degree in Electrical Engineering from Illinois and entered the Graduate Training Course at Allis-Chalmers in 1925. During the 2-year course I stuck pretty close to electrical work—and at its completion, I was on the electrical test floor helping run tests on some of the first big blooming mill motors the company ever built.

Next, I worked in the Basic Industries Department on electric mine hoists. In 1931, I moved back to the Electrical Department, doing sales application work for the Motor and Generator Section. I worked, successively, on unit sub-stations, had charge of the Mixed Apparatus Section, was in Industrial Sales, handled contract negotiations and sales liaison work during the war, and in 1947 took charge of the company's growing Electronics Section.

Hardening 2200 trimmer blades per hour, this Allis-Chalmers Induction Heater is stepping up production for a Southern manufacturer of textile machinery.

Massive castings for a 60-inch Superior-McCully crusher being assembled in the A-C West Allis plant. Machine will reduce 5-foot boulders to crushed rock—handle 2500 tons of ore per hour!

Here we develop and apply four main classes of industrial electronic equipment: Rectifiers, Induction Heaters, Dielectric Heaters and Metal Detectors. With the exception of Rectifiers, this equipment is relatively new to industry. We're turning up new uses and applications every day. It's an absorbing line of work, and pioneers an entirely new frontier of industrial methods.

Wide Choice of Interests

I've traced this brief personal history to illustrate the widely varied opportunities a young engineer finds at Allis-Chalmers even within a single field such as electricity. I never got far from the Electrical Department, because I found what I wanted right there. But I wouldn't be giving a true picture of Allis-Chalmers if I didn't touch on the other great departments, covering just about every major industry.

Many GTC students find their greatest interest and opportunity in the Basic Industries Department. There they design, build and install the machinery for mining, smelting, cement making, flour milling, oil extraction, food and chemical processing. Others become interested in hydraulic or steam turbines, the complexities of centrifugal pumps and the engineering problems of small motors or V-belt drives.

Some fit into engineering and design. Some find themselves most interested in manufacturing or in field work such as service and erection. Many like selling, and find their engineering training pays off best in a District Sales Office.

Whatever a man may eventually find most to his liking and advantage, the Allis-Chalmers Graduate Training Course is a wonderful vantage point from which to start. It offers contact with all major industries, and a chance at many types of work: design, manufacture, research, testing, installation, selling, advertising, export. There is no other organization that can offer a graduate engineer such a wide range of activities.

ALLIS-CHALMERS

Allis-Chalmers Manufacturing Company, Milwaukee 1, Wisconsin

Alumni News

(*Continued from page 17*)

W. Harry Johns, Jr., A.E.M.E. '39, is Institutional Supervisor for the New York Sales Department, Time Recording Division, International Business Machines, New York; lives at 17 Port Washington Blvd., Port Washington, N. Y.

Teh-Chang Koo, M.E. '40, is vice-president, assistant manager, and a director of the Bangkok Cotton Mills, Ltd., 34, Mansion 5, Rajdamnern Avenue, Bangkok, Thailand.

William K. Stamets, Jr., B.M.E. '42, M.M.E. '49, has opened a consulting engineering office in the Hoge Bldg., Seattle, Washington, where he specializes in the design of special purpose machinery, production engineering and industrial management. He was formerly an instructor in the machine design department at Cornell, and now holds the offices of vice president and director of the William K. Stamets Co., machine tool manufacturers of Pittsburgh and Cleveland.

Robert O. Gundlach, B.S. in A.E. '42, is sales engineer in the air-conditioning and refrigeration division at the New York office of Worthington Pump and Machinery Corp.

Frederic C. Burton, B.C.E. '42, has been made chief engineer of African Petroleum Terminals, Ltd., and his address is PO Box 526, Accra, Gold Coast, West Africa. He would like to meet other Cornellians in that area and hopes to get back to the United States on leave in early spring.

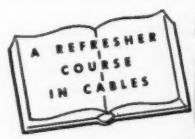
John C. L. Fish, C.E. '92, emeritus professor of civil engineering at Stanford University, recently finished the preparation of the second edition of *The Engineering Profession,* which, with T. J. Hoover, he published in 1941. Professor Fish lives at 1336 Emerson St., Palo Alto, Calif.

LaRoy B. Thompson, B.Chem.E. '43, was appointed coordinator of industrial research at the University of Rochester. He joined the University of Rochester 130-inch cyclotron project in December, 1946, and since July, 1947, has divided his time between the Rochester project as administrative aide, and the synchrotron project at Cornell as engineer. He was a group leader of the design and production group for the Bikini bomb tests.

W. Nicholas Kruse, B.Chem.E. '43, who is with Universal Oil Products Co., 310 South Michigan Ave., Chicago, Ill., is assisting in the initial operation of the first commercial "platforming" process for upgrading of straight run gasoline at Old Dutch Refining Co., Muskegee, Mich.

William N. Taylor, B.Chem.E. '44, married Evelyn V. Thiede of Westfield, N.J., on July 16, 1949. He was recently transferred from the

(*Continued on page 36*)



THE SOURCE OF A RIVER IS THE SOURCE OF

QUALITY . . . From the headwaters region of the Amazon comes Up-River "Fine Para", widely acknowledged by rubber experts as the highest grade of natural rubber. *To Okonite researchers and independent experts alike,* long experience has shown that only this rubber provides all the factors needed in top quality insulation for electrical wires and cables.

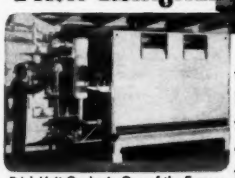
The Okonite Company obtains a high degree of uniformity in shipment after shipment of this premium rubber in "biscuit" form . . . has found that Up-River Fine Para assures a long service life . . . uses it exclusively in all Okonite rubber insulated wires and cables. The Okonite Company, Passaic, New Jersey.

6964

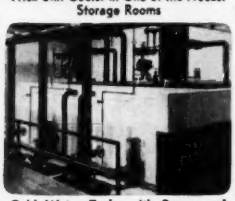
OKONITE

insulated wires and cables

BIG NEW DAIRY PRODUCTS PLANT EQUIPPED WITH Frick Refrigeration



Frick Unit Cooler in One of the Freezer Storage Rooms



Cold Water Tanks, with Pumps and Ammonia Control Equipment

Frick 11" by 10" Ammonia Compressors, with Steam Engine Drives

The M & R Dietetic Laboratories, Inc. will manufacture SIMILAC, the well-known baby formula, and TEN-B-LOW, a concentrate for making ice cream in the home, in their new plant at Sturgis, Michigan.

A complete Frick refrigerating system serves the great plant. Temperatures range from 10 deg. below zero to 40 above. Features of the cooling system are steam drive for two of the compressors, a booster compressor for low-temperature work, and two cold water tanks arranged for storing refrigeration by freezing ice on the pipe coils.

The Frick Graduate Training Course in Refrigeration and Air Conditioning, Operated over 30 years, Offers a Career in a Growing Industry.

FRICK & CO.
WAYNESBORO, PENNA.

SHOCK STRENGTH

Without shock strength—or, for that matter—without all of the strength factors listed opposite—no pipe laid 100 years ago in *city streets* would be in service today. But, in spite of the evolution of traffic from horse-drawn vehicles to heavy trucks and buses—and today's vast complexity of subway and underground utility services—cast iron gas and water mains, laid over a century ago, are serving in the streets of more than 30 cities in the United States and Canada. Such service records prove that cast iron pipe combines all the strength factors of long life with ample margins of safety. No pipe that is provably deficient in any of these strength factors should ever be laid in city streets. Cast Iron Pipe Research Association, Thos. F. Wolfe, Engineer, 122 So. Michigan Ave., Chicago 3.

Strength factors of Long Life!

No pipe that is provably deficient in any of these strength factors should ever be laid in city streets

SHOCK STRENGTH — The toughness of cast iron pipe which enables it to withstand impact and traffic shocks, as well as the hazards in handling, is demonstrated by the Impact Test. While under hydrostatic pressure and the heavy blows from a 50 pound hammer, standard 6-inch cast iron pipe does not crack until the hammer is dropped 6 times *on the same spot* from progressively increased heights of 6 inches.

CRUSHING STRENGTH — The ability of cast iron pipe to withstand external loads imposed by heavy fill and unusual traffic loads is proved by the Ring Compression Test. Standard 6-inch cast iron pipe withstands a crushing weight of more than 14,000 lbs. per foot.

BEAM STRENGTH — When cast iron pipe is subjected to beam stress caused by soil settlement, or disturbance of soil by other utilities, or resting on an obstruction, tests prove that standard 6-inch cast iron pipe in 10-foot span sustains a load of 15,000 lbs.

BURSTING STRENGTH — In full length bursting tests standard 6-inch cast iron pipe withstands more than 2500 lbs. per square inch internal hydrostatic pressure, which proves ample ability to resist water-hammer or unusual working pressures.

CAST IRON PIPE SERVES FOR CENTURIES

...PUMPING WITH Economy!
Economy Non-Clogging Sewage Pump
Economy Double Suction Pump
Economy Axial Flow Pump
ECONOMY PUMPING makes sound sense to engineers who know the dollars and cents value of trouble-free pumping service. To pump longer, at lower cost, with less maintenance, rely on Economy Pumps.
Centrifugal, axial, and mixed flow pumps for all applications.
For complete details on any Economy Pump, write Dept. L-12 Please specify type pump in which you are interested.
Economy Pumps, Inc.
Division of Hamilton-Thomas Corp.
HAMILTON, OHIO
ACCURATE, DEPENDABLE REGULATION
CLOSER REGULATION . . . more accurate control . . . that's been the forty year service record of Klipfel Automatic Regulating Valves on installations throughout the land.
Klipfel exclusive design inner valves assure better closing, more dependable regulation.
Complete line includes pressure reducing valves, float and lever valves, thermostatic valves, back pressure and relief valves and pump governors.
For complete details on any Klipfel Valve, write Dept. L-12 Please specify type valve in which you are interested.
Klipfel Ball Type Reducing Valve
Klipfel Spring Loaded Thermostat
Klipfel
MANUFACTURING COMPANY
DIVISION OF HAMILTON-THOMAS CORP.
HAMILTON, OHIO

Alumni News

(*Continued from page* 34)

Technical Service Division of the Bayonne, N.J., refinery of Esso Standard Oil Co. His address is 426 Vine Street, Elizabeth, N.J.

Frederick J. Kircher, B.C.E. '46, married Betty A. Mueller, September 17 in Caldwell, N.J. They live in Apt. 67D, Brookdale Gardens, Bloomfield, N.J. Kircher is a structural designer with Seelye, Stevenson and Valve, consulting engineers in New York City.

Norman Dawson, Jr., B.M.E. '46, is assistant plant engineer at Macwhyte Wire Rope Co. in Kenosha, Wisconsin. Mr. and Mrs. Dawson **(Marilyn King, '48)** live at 6536 Fifth Ave., Kenosha, where a son, Thomas, was born to them August 23.

Albert J. Eisenberg, B.E.E. '46, recently left Sightmaster Television Corp. where he was supervisor of the production test department, to become director of field engineering for Field Radio Corp. He lives at 351 Broadway, Lawrence, Long Island.

Thomas M. Berry, B.C.E. '47, project engineer for the contracting division of the Dravo Corp., Pittsburgh, Pa., is located on a project of installing river loading facilities for Weirton Steel Co., at Little Falls, W. Va.

John N. Cullen, B.M.E. '48, class secretary, of 1510 Cole Road, Whittier, Calif., wants to hear from classmates who would like to be on the reunion committee. Cullen, a petroleum engineer with Standard Oil of California, has been on the West Coast since last March.

Albert W. Dauer, B.Chem.E. '48, Box 807 Vivian, La., is a chemical engineer for Stanolind Oil and Gas Co. of Superior Refinery. He was formerly in Stanolind Division office in Oklahoma City.

Bart E. Holm, B.C.E. '48, recently married to Kathleen F. Masson, Michigan State '47, is with The Standard Oil Co. (Ohio) in Cleveland. Their address is 13602 Argus Ave.

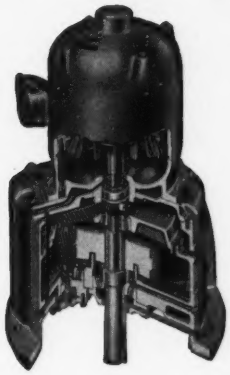
Melvin F. Bennett, B.C.E. '49, of RD 1, Newburgh is with Smith-Stewart Co. heating and steel fabrication. He is engaged to Elizabeth Babiy, daughter of Dr. P. Peter Babiy of Salzburg, Austria, formerly instructor in Entomology.

Harold W. Ferris, B.M.E. '49, is training for a supervisory position at National Malleable and Steel Castings Co. of Sharon, Pa. His address is 1497 Highland Road in Sharon.

Albert J. Audheusdan, Jr., B.C.E. '49, an engineer with Bethlehem Steel Co., is engaged in the construction of the Mississippi Bridge at St. Louis, Mo. His address is YMCA 1528 Locust Ave. in St. Louis.

(*Concluded on page* 38)

Another page for **YOUR BEARING NOTEBOOK**

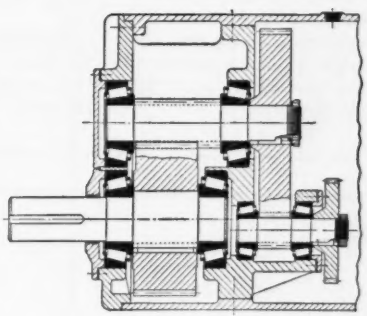


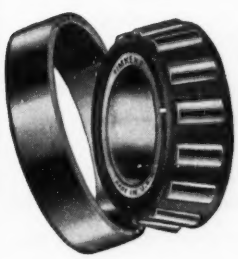
How to help a gearmotor take care of its teeth

To minimize wear on the teeth and to insure smooth, quiet operation, reduction gears in motors like this must be held in perfect mesh, no matter what the load. That's one reason why engineers mount the gear shafts on Timken® tapered roller bearings. Timken bearings hold the shafts in accurate alignment. Gears are kept perfectly positioned, with each tooth meshing smoothly and carrying its full share of the load.

Gears mesh smoothly, wear longer, with shafts on TIMKEN® bearings

Here is a typical gear-case countershaft showing a common method of mounting Timken bearings. Due to the line contact between the rolls and races, Timken bearings give the shaft maximum support. There's less chance of deflection under load. The tapered bearing design takes both radial and thrust loads in any combination. End-movement of the shaft is kept to a minimum. Gears wear longer—work better.





TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

Want to learn more about bearings?

Some of the important engineering problems you'll face after graduation will involve bearing applications. If you'd like to learn more about Timken bearings and how engineers use them, write today to The Timken Roller Bearing Company, Canton 6, Ohio. And don't forget to clip this page for future reference.

NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL ◐ AND THRUST ⊣◐⊢ LOADS OR ANY COMBINATION ✳

Alumni News

(*Continued from page 36*)

George Howitt, B.E.E. '49, married Naomi Rubenstein of Brooklyn August 28. They live at 14-19 Chandler Drive, Fair Lawn, N.J. Howitt is an electrical engineer at the Allen B. Dumont Laboratories in East Paterson, N.J.

Stanley K. Kempner, B.M.E. '49, of 56 De Mott Avenue, Baldwin, is fire prevention engineer for the Eastern Inspection Bureau.

Walter J. McCarthy, B.M.E. '49, B.S. '45, M.S. in Ed. '47, and Mrs. McCarthy **(Alice Ross A.B. '45)** live at 13-49B Sperber Road, Fair Lawn, N.J. McCarthy is a cadet engineer with the Public Service Electric and Gas of Newark, N.J.

Henry Rubin, B.M.E. '49. Henry Rubin joined the New York Housing Authority as a construction engineer August 15 and is located at the Albany Housing Project, 1195, Park Street, Brooklyn.

Donald A. Weiss, B.M.E. '49, USN Ensign, was commissioned at the University in June, and is now a gunnery officer on the Spokane, a light anti-aircraft cruiser operating in the Atlantic fleet, outside of Norfolk, Va., for six months and then in the Mediterranean for six months. He is the son of **Bertrand Weiss C.E. '09.** His address is USS Spokane, CL 120, FPO, New York City.

John E. Wolf, B.M.E. '49, is participating in a special training program for recent mechanical engineering graduates conducted by Johnson Service Company, Milwaukee, Wis., manufacturers, engineers and contractors for automatic temperature and air conditioning control systems. Upon completion of the course, Wolf will be assigned to Johnson's Buffalo, N.Y. branch as a sales engineer.

Edwin M. Greenthal, B.E.E. '49 of 2520 Marion St., Milwaukee, Wis., is studying law at the University of Wisconsin.

Flashbulbs

(*Continued from page 12*)

accomplished through the use of filters over the camera lens it is much easier to use colored, rather than clear lacquer as the final coating on the bulb. If it is desired to raise the color temperature of the light a red lacquer is applied. If the color of the light needs to be colder, a blue lacquer can be used. One special type of lacquer holds back all visible light and allows only infra-red rays to escape from the lamp. Using infra-red coated bulbs and special infra-red sensitive film, photographs can now be made in complete darkness.

Undoubtedly, with the passing of time, the flash-bulb will be perfected to an even greater degree than at present. At the present time, however, it has become an invaluable adjunct to the camera of almost every interested camera fan or professional photographer.

*The author wishes to thank the General Electric Company for its help in the paragraphs dealing with flashlamp manufacture.

NORTON
Printing Co.
317 E. State St.

OUR NEW TELEPHONE NUMBER

4-1271

IT'S TIME TO ORDER
YOUR CORNELL CLASS RING !

As the end of the college year approaches, delivery of class rings is not quite so prompt, but if you place your order now, we can offer delivery in from three to four weeks.

THE CORNELL CLASS RING
FOR MEN

Medium or heavy weight, 10K gold or sterling silver.

$18.00 to $39.60
(tax included)

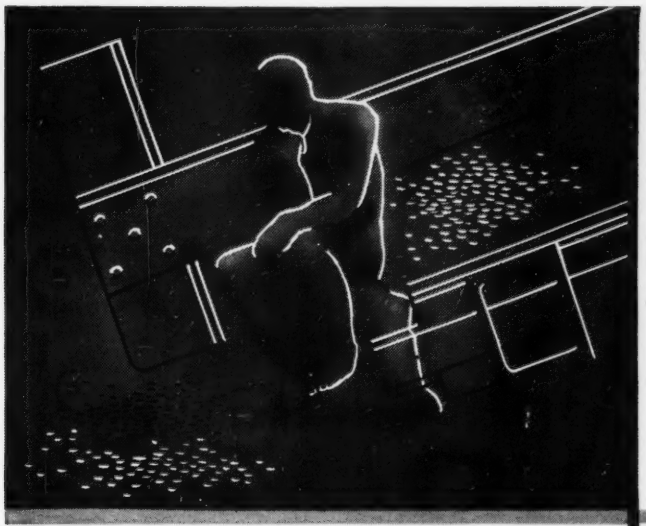
THE CORNELL CLASS RING
FOR WOMEN

10-K gold with sardonyx stont cut with "C" and class numerals.

$19.20
(tax included)

We would like to show these fine rings to you at your convenience.

THE CORNELL CO-OP
Barnes Hall On The Campus



Thinking of improving

"Improving" any machine really means increasing its productive capacity. That means tinkering with speeds and weights and strength—ending up with alloy steels.

Which alloy steel?—the one that meets physical requirements at the lowest cost. Molybdenum steels fill that bill. Good hardenability, plus freedom from temper brittleness, plus reasonable price enable them to do it.

Send for our comprehensive 400-page book, free; "MOLYBDENUM: STEELS, IRONS, ALLOYS."

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS

Climax Molybdenum Company
500 Fifth Avenue • New York City

MOLY

C2

STRESS and STRAIN...

Conductor on Pullman car: "Ignatius!"

Porter: "Yassuh?"

Conductor: "What's the idea of the red lantern hanging outside of that berth?"

Porter: "Well, suh, it says right here in my rule book that Ah's supposed to hang out a red lantern when the rear of the sleeper is exposed."

* * *

Why Locomotives Are Called She

They wear jackets with yokes, pins, shields, and stays. They have aprons and laps too. Not only do they have shoes, but have short pumps and even hose while they drag trains behind them.

They also attract attention with puffs and mufflers and sometimes they refuse to work. At such times they need to be switched. They need guiding and require a man to feed them. They all smoke, and are much steadier when they are hooked up.

* * *

Judge: "So your name's Joshua, eh? You're not the Joshua that made the sun stand still, are you?"

Culprit: "Lor' no, Judge. Ah'm de Joshua dat made de moonshine."

* * *

Brain-busters

It is often the boast of the faculty of the College of Engineering that Cornell Engineers are taught how to think rather than how to memorize. This page will provide a test of that statement. In fact, these brain-busters are guaranteed not only to harass the already over-burdened student even more, but they might very well provide a few moments of thought for faculty members. Better keep these problems on file—your next year's prelims may contain one!

The first question concerns the proverbial bad penny that keeps turning up, in this case in the company of eleven perfectly good pennies. All twelve look exactly alike, but the counterfeit is heavier. With the use of a pan balance only, what is the least number of weighings necessary to determine which is the bad penny, chance not aiding? If you think that's too easy, try it with a bad penny which is either heavier or lighter, no one knows which to begin with.

This brings up the story of an EE who offered to wire up the lights on his fraternity's Christmas tree. Something, however, went wrong with his circuit, and when it came time to turn on the lights, they behaved very strangely. There were twenty bulbs in all. The switch was thrown once and only the first bulb went on. The switch was thrown a second time and the first bulb went off while the second went on. When the switch was thrown again, both bulbs went out. By repeatedly throwing the switch, the bulbs were found to follow a definite pattern. Each time a bulb went off, the one following it changed, i.e. went out if it was on or on if it was out. If a bulb went out, it changed nothing either before or after. The whole thing was triggered by the first bulb which changed each time the switch was thrown. (The following diagram shows the course of events for the first six throws of the switch.) How many times did the switch have to be thrown before all twenty bulbs were on? When you figure this out, you'll see why our poor EE didn't show his face for a while.

1	2	3	4	...	20
ON					
OFF	ON				
ON	ON				
OFF	OFF	ON			
ON	OFF	ON			
OFF	ON	ON			
ON	ON	ON			
OFF	OFF	OFF	ON		

etc.

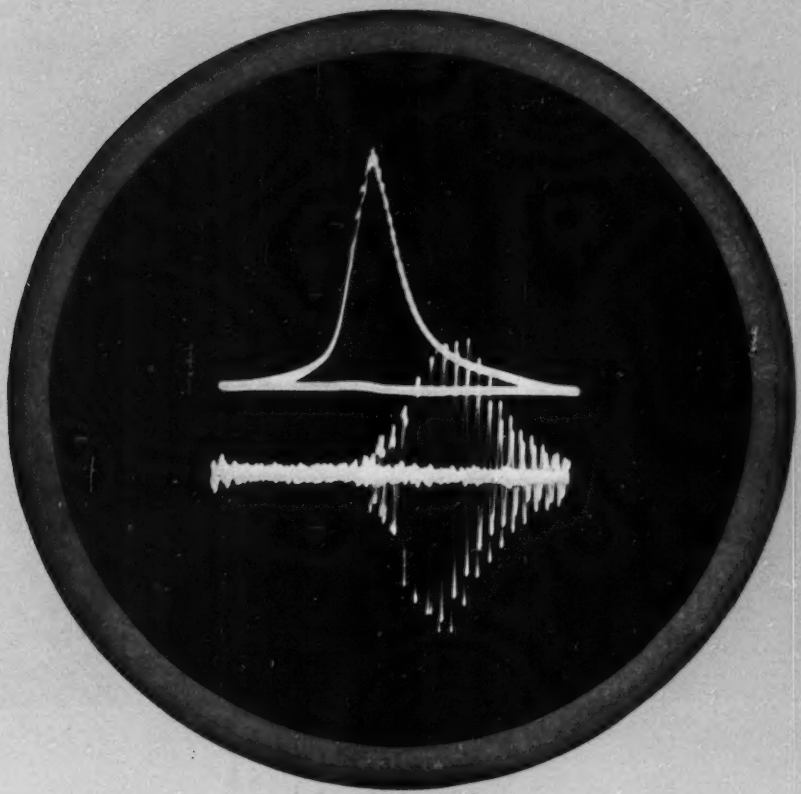
Here's one for the ME's. There are two gear wheels of equal size. One rotates around the other, which is stationary. How many times will the first one turn on its own axle?

This story concerns three Chem-E's, all wanting admission to the school. There was only one place remaining, and the qualifications for all three seemed equally good. Finally a test was decided upon. Each man was blindfolded and either a black or white hat was put on his head, but he did not know which. Each was told that when the blindfold was removed he should raise his right hand if he saw either one or two black hats on the heads of his companions. When the blindfolds were removed, each saw two black hats and raised his right hand. In a little while, one said, "I have a black hat." How did he figure it out?

The best-laid plans of mice, men and physicists often go wrong, and one dark and wintry day in Rockefeller all the fuses blew. In one lab section, however, two candles were used to provide a little light. They were of equal length, but one was a little thicker than the other and would burn five hours, whereas the other would only last four. The candles were lit, but the fuse was replaced before they burned out. It was found that the stump of one candle was four times the length of the other. How long did it take to replace the fuse?

This last problem is one that is supposed to distinguish a mathematician from a physicist, and we include it for the benefit of those EP's who aren't sure what they are. Two trains start out 60 miles from each other and at right angles. They are traveling 20 miles an hour on the average. A bee is flying directly from one to the other and back again all the time at a rate of 30 miles an hour. When the two trains finally meet, how far a distance has the bee traveled?

As for the answers to these puzzles, tune in next month and find out!



This is a picture of "PING"

It's a picture that gives automotive engineers clear-cut facts on performance—a picture that suggests how photography with its ability to record, its accuracy and its speed, can play important roles in all modern business and industry.

No, this is not the "doodling" of a man on the telephone. Far from it. It's the photographic record of an oscilloscope trace that shows, and times, detonation in a "knocking" engine. It all happens in a few hundred-thousandths of a second—yet photography gets it clearly and accurately as nothing else can.

Oscillograph recording is but one of countless functional uses of photography in bettering products and improving manufacturing methods. High speed "stills" can freeze fast action at just the crucial moment—and the design or operation of a part can be adjusted to best advantage.

And high speed movies can expand a second of action into several minutes so that fast motion can be slowed down for observation—and products be made more dependable, more durable.

Such uses of photography—and many more—can help you improve your product, your tools, your production methods. For every day, functional photography is proving a valuable and important adjunct in more and more modern enterprises.

Eastman Kodak Company, Rochester 4, N. Y.

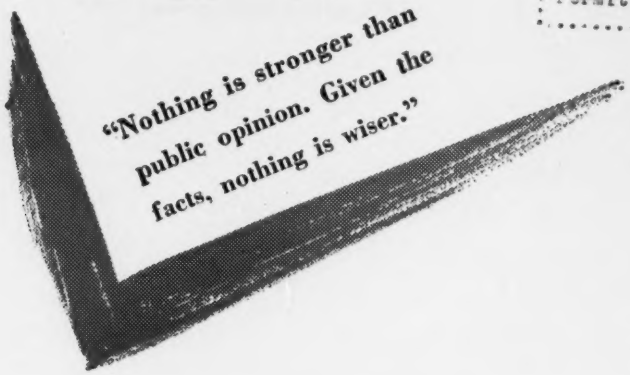
Functional Photography

. . . is advancing business and industrial technics

Kodak
TRADE-MARK

University Microfilms
313 N. First St.
Ann Arbor, Mich.

U.S. Postage
PAID
Ithaca, N.Y.
Permit No. 176



On Competition

Hatch a good idea and you hatch competitors.

It works this way—to take General Electric as an example:

In 1934, the automatic blanket was initially developed by General Electric. Today there are twelve other companies making electric blankets in competition with G. E.

In 1935, General Electric first demonstrated fluorescent lamps to a group of Navy officers. In 1938, the first fluorescent lamps were offered for sale. Today they are being manufactured by a number of companies.

The first turbine-electric drive for ships was proposed and designed by G-E engineers. Today four companies in this country build this type of ship-propulsion equipment.

After several years of laboratory development, General Electric began production and sale of the Disposall kitchen-waste unit in 1935. Today fourteen other companies are in this field.

The first practical x-ray tube, developed at General Electric years ago, is now a highly competitive business for seven manufacturers.

In 1926, a practical household refrigerator with a hermetically sealed unit was put on the market by General Electric. Today 34 companies are manufacturing household refrigerators with hermetically sealed mechanisms.

* * *

Research and engineering snowplow the way, not only for new public conveniences, but also for new companies, new jobs.

There are 20% more businesses today than there were immediately after the war.

Industry furnishes over 10,000,000 more jobs than ten years ago.

The average family owns more and better products of industry than ten years ago.

Any American company that plows back money into research and engineering development makes new business not only for itself, but for others.

The economy that does most to foster competition is the one that makes easiest the establishment and growth of business.

You can put your confidence in—

GENERAL ELECTRIC